THE

TWELVE PRINCIPLES OF EFFICIENCY

BY

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INTRODUCTION

Harrington Emerson's earlier book "Efficiency as a Basis for Operation and Wages" appeared originally in 1908, and a third edition, revised and enlarged, is being reissued almost in parallel with this second and later work on "The Twelve Principles of Efficiency." The relations between the first and second presentations of the subject thus become clear. The former sets forth a new view of the whole industrial problem and of the relations and proportions of the factors entering into it. It is the declaration of a philosophy. This latter work, stronger even than its predecessor, and more specific in statement, reduces the doctrine of efficiency to a code upon which to base rules of practice.

In the volume now published, the author defines twelve principles by which efficiency is determined. Five of these concern relations between men—or, in the industrial problem, specifically between employer and employee. Seven of them concern methods or institutions and systems established in the manufacturing plant or in the operating and distributing company. These twelve principles are so definite, so constant, so true, that they may be used as gauges. Any industry, any establishment, any operation, may be tested thereby, and its inefficiency located and measured by the amount of its failure to conform to one or more of the twelve principles.

Yet the twelve principles are not isolated and independent influences, but are interdependent and co-ordinated—related to one another (in the author's effective simile) as the stones of a dome. One or even several may be lacking; yet the structure, though weakened and imperfect, will stand. From a wholly material, non-moral, and near-visioned point of view, indeed, the seven "practical" principles alone would be sufficient for the achievement of success. Even an evil purpose can be most effectively accomplished by their observance. When, however, these are interlocked with the five "altruistic" principles, purposes, as well as measures, are turned from lower temporary desires to the larger eternal desirabilities. The doctrines of efficiency therefore define something infinitely greater than a system of management. They set forth a morality, and provide practicable measures for its attainment.

The method of treatment is simple and logical. An introductory chapter lays down the premise that the prime institutions for the attainment of efficiency are not men, materials, money, machines, methods, but theories of organization and principles, and that inefficiency prevails because the type of organization in general use does not lend itself to the application of efficiency principles. The second chapter discusses the type of organization under which efficiency principles can be successfully applied. The twelve following chapters take up each one a single principle:—1. Ideals; 2. Common-Sense and Judgment; 3. Competent Counsel; 4. Discipline; 5. The Fair Deal; 6. Reliable, Immediate and Accurate Records; 7. Planning and Despatching; 8. Standards and Schedules; 9. Standardized Conditions; 10. Standardized Operations; 11. Written Standard-Practice Instructions; 12. Efficiency Reward. Two concluding chapters show how the principles are applied as a means of diagnosis of industrial conditions and correction of existing inefficiencies.

CHARLES BUXTON GOING.

Lord, Thou hast made this world below the shadow of
a dream . . .
I'll stand the middle watch up here—alone wi' God an'
these
My engines . . .
. . . through all the seas of all Thy world . . .
. . . What I ha' seen since ocean steam began
Leaves me no doot for the machine: But what about
the man?
The man that counts, wi' all his runs . . .

"Mister McAndrews, don't you think steam spoils
romance at sea?"
Damned ijjit! . . . Romance!

Lord, send a man like Robbie Burns to sing the Song
o' Steam!
. . . True beat, full power, the clangin' chorus goes
Clear to the tunnel where they sit, my purrin' dynamos.
Interdependence absolute, foreseen, ordained, decreed,
To work, ye'll note, at any tilt an' every rate of
speed . . .
An' singin' like the Mornin' Stars for joy that they
are made. . . .
Now, a'together, hear them lift their lesson, theirs an'
mine:
"Law, Order, Duty an' Restraint, Obedience, Disci-
pline!" . . .
Oh for a man to weld it then, in one trip-hammer
strain . . .
An' by that light—now, mark my word—we'll build the
Perfect Ship.

RUDYARD KIPLING; *McAndrew's Hymn.*

PREFACE

Why has the time come to discard the old and use the new?

What past truths have become fallacies?

What new truths are becoming basic?

Why has this book been written?

These are some of the queries to which the reader may justly expect answers, especially if they reveal the point of view from which the principles of efficiency have been collated, elaborated, and applied.

"What about the man?" What about humanity, present and future? This is the test to be applied to every ideal, to every organization, to all equipment; the ideal of humanity is to be kept burning by every executive, because the ideal of humanity, not the ideal of selfish gain, underlies every principle of efficiency.

My eldest daughter accuses me of starting every discussion with the period before Adam. This is perhaps due to a lingering, but almost obliterated, trace of German *Gründlichkeit* pounded into me in German schooldays. (From the remote beginning there have been forward steps which we now clearly see, but which were not perceived at the time.) French teaching, of which I also had full share, if not so thorough as German, is far more logical and clear. The French always seek causes and accept what flows from them.

Beginning, therefore, before Adam, we can go back to a time when there was no life on this planet, when molar, molecular, and corpuscular forces were active, and in strict obedience to unsentient law, there was the logical morality of the conditions. The moralities of physical movements, of chemical affinities, of corpuscular activities, are teaching us more and more; they are still our foundations.

After a long while life came to our earth, and its one morality seems to have been "Every creature for itself and its descendants." Between species and species there was no justice, no mercy; between individual and individual, no justice, no mercy; only a dawning of morality in conjugal and parental love. In those days, deceit, rapacity, cruelty, dishonesty, unchastity were the great virtues since only those survived who practiced them most assiduously.

Then man appeared, and practising all the old virtues, he slowly evolved a higher morality. "Thou shalt not steal, thou shalt not kill, thou shalt not commit adultery, thou shalt not bear false witness, thou shalt love they neighbor as thyself." The tenets of all the great religions exhale the individual duty to the individual neighbor. From the period of this higher but narrow morality we are just emerging.

In the last 150 years another event has occurred, next in importance to the advent of life, to the advent of humanity. This event is the substitution of coal, oil, gas, and distant waterfalls for human, for animal muscular energy, for nearby use of wind and water current. Formerly men carried out their plans by forcing other men, by compelling asses, oxen and horses to work for them.

Now men carry out their plans by making uncarnate forces work. Two men or two horses working together work more efficiently than four; one man or one horse singly works more than half as much as two working together. The most efficient incarnate unit is therefore one man, one horse. How does man power or horse power compare with uncarnate power?

COMPARISONS

	Man.	Horse.	Power Engine.
Weight per horse power, pounds	1,000	1,000	2 to 100
Fuel per horse-power hour, pounds	6	3.6	0.5 to 3
Cost of food per ton	$40	$20	$1 to $40
Maximum horse power, per unit	⅛	1.	70,000 or more
Available working time, per cent	40	40	40—90

Tilling the soil even with so perfected a tool as a good spade, it would take 560 seasons to turn over a square mile of land, 640 acres. A man with a team and good plow can do it in four seasons. I tried it and became discouraged. Twelve men with three mechanical tractors and fifty-one plows in a gang can turn over 640 acres in 36 hours. I have a photograph of the outfit at work.

PER CENT OF ENERGY FROM FUEL

Small steam plant	5
Man working steadily in a manual trade	7
Large steam or oil plant	10
Small gas engine	20
Man working for a short time at maximum of endurance	21
Large gas engine	30

At $2.00 a day, man power costs per horse power, $54,000 per year of 7,500 hours. In a small gasoline engine it costs $300 a year per horse power; for large power installations, whether steam, gas or electrical, it costs from $20 a year up to $200 per horse power. Man power costs therefore from 135 to 1,350 times as much as uncarnate power.

Thirty men, as men work, will yield 1 horse power of energy each hour, but so will 1 to 5 pounds of coal. A ton of coal may be assumed to have the energy of five men for a whole year.

One hundred and sixty years ago the use of coal had not yet begun on a commercial scale; all the work was done by man and beast. Sixty years ago in the United States the consumption of coal, used most wastefully, was one-quarter ton per adult male, each ton able to do the work of five men. Today the consumption of coal is equal to the energy of 22 men and the energy from oil, from gas, from distant waterfalls, is not included.

On the average each adult man is supplemented by 22 mechanical slaves whose keep averages less than one four-hundredth of his own value of $2.00 a day.

As a producer of muscular energy man is hopelessly outclassed, as an intelligent supervisor and director he is just beginning to come into his inheritance. In these directions he has no competition nor limit to his value.

It is true that in the ages from which we are just emerging, the wealth of the few was based on the poverty of the many. The free inhabitants of Athens reached the highest state of real civilization the planet has ever seen because for every free man there were at least five slaves. Pharaoh, advised by Joseph, grew rich by using the seven years of famine to rob his people of their money, their savings, their cattle, their lands and their liberty. As slaves they could be and were requisitioned to do muscular work, as beating the ponds at night to scare the frogs that their masters might sleep, or to swing fans all night, as in India today, that the rich may slumber. Those few who were rich were supported by the labor of the many. Today this is not so.

If some gifted thinker should discover a method of making the sun convert lead into radium, a million times more powerful than coal, he would have robbed no one, he would have impoverished none, he would immensely benefit humanity, even though the discovery netted him $1,000,000,000.

Muscular energy no longer counts for much. The world's energy comes from engines, and any man who develops a tool or machine to do work formerly done by men is adding to the number of tireless slaves who serve first the inventor and then all humanity. It is not true that a machine permanently displaces a man; it promotes him, but it is the duty of corporations and of the State to make the period of transition easy, not one of temporary hardship.

It is not labor, not capital, not land, that has created modern wealth or is creating it today. It is *ideas* that create wealth, and what is wanted is more ideas—more uncovering of natural reservoirs, and less labor and capital and land per unit of production. Gold has very little intrinsic value, diamonds have none except to cut glass and stone. It is a thought, a sentiment, that gives value to gold and diamonds; it was the invention of the incandescent lamp that doubled the value of platinum. Columbus with his idea of land to the west, Franklin, Washington, Jefferson, with their ideas of liberty, Jefferson with his idea of territorial expansion, Fulton with his idea of the steamboat, Stephenson with his creation of the locomotive and track; it was Howe, Morse, Edison, Westinghouse, Bell and Gray, Marconi;

it was Lincoln, it was Rockefeller, Carnegie, J. J. Hill and Harriman with their ideas, it was Roosevelt with the Panama Canal, that have made the United States what it is. All these men used labor and capital to uncover and develop the hitherto unutilized resources of the universe.

The Dutch and the Huguenots settled in South Africa about the same time North America above the gulf was colonized. The United States grew on account of ideas; South Africa remained undeveloped because of paucity of ideas, paucity of energy. The blacks had to do the work. There was no use for steam engines.

Muscular effort can be stimulated by the lash—intelligent supervision, intellectual production, never! One single idea may have greater value than all the labor of all the men, animals, and engines for a century. The age of muscular human effort and of the lash is passing away, and the old morality with it; the age of supervision, of co-operative stimulus, is in full advance; and with it comes a new morality, under which the Golden Rule can be extended from the relations between individuals to those between classes, nationalities, and races. The highest official cannot dictate to the youngest apprenticed worker. Both are creatures of the machine, but both in turn must serve it, for unless its every law and need is lived up to, it will refuse to work efficiently, often refuse to work at all. With these new duties and privileges of men toward each other old truths become fallacies and paradoxes become the basic truths of tomorrow.

To forward the new morality, to extend the dominion of man over uncarnate energy and its use, to substitute highly paid thinkers and supervisors for devitalized toilers, to help each individual, each corporation, each government to meet its part of the obligation, above all to inspire those executives on whose skill all progress and all wise performance depends, is the justification of these essays.

HARRINGTON EMERSON

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THE TWELVE PRINCIPLES OF EFFICIENCY.

The wise man built his house upon a rock; and the rain descended, and the floods came, and the winds blew, and beat upon that house; and it fell not; for it was founded upon a rock. But the foolish man built his house upon the sand; and the rain descended, and the floods came, and the winds blew, and beat upon that house; and it fell; and great was the fall of it.—*St. Matthew*, 7, 24-27.

He also that is slothful in his work is brother to him that is a great waster.—*Proverbs*, 18, 9.

By the wisdom of the centuries I speak,
  To the tune of yestermorn I set the truth;
I, the joy of life unquestioned; I, the Greek;
  I, the everlasting wonder Song of Youth!

RUDYARD KIPLING.

THE TWELVE PRINCIPLES OF EFFICIENCY

CHAPTER I

ORGANIZATION AND PRINCIPLES THE PRIME INSTRUMENTS FOR EFFICIENCY

The invisible makes the nation. The nation is not made great, it is not made rich, it is not made at all, by mines and forests and prairies and water powers. Great men make a great nation great, and the qualities that make men great are invisible.—LYMAN ABBOTT.

THE owners of a large industrial plant with many orders ahead desired to increase the output from thirteen units a month, the highest average up to that time, to twenty-three units a month, and to do this in ten months.

The manager of the plant, a man of unusual ability but of the old school, had been in charge for some time, but knew only one way to deliver the increase, namely, to add to equipment and employ more men. He therefore countered the demand of the owners for twenty-three units by asking for $500,000 worth of additional equipment. Even if this capital investment had been possible, it was no solution of the difficulty, as it would have taken at least a year, probably longer, to secure the new equipment.

When matters were in this state—demand for increased output by owners, demand for increased equipment by manager—an investigation of the plant was made by two competent efficiency engineers of wide experience, who submitted a long report of which the concluding paragraphs were:—

Your plant consists of a large
Machine Shop,
Boiler Shop,
Erecting Shop,
Blacksmith Shop,
Foundry.

Having examined into the conditions of each of the shops and having consulted with the manager, the superintendent, the various foremen, some of the contractors, and a number of men, we are able to state definitely that with some slight physical betterments, and provided the present manager, or a man of similar disposition be in authority, the output of your shops can be increased 60 per cent, without adding to the present forces, without adding to the equipment, and without increasing the payroll more than 10 per cent, and that these results can be gradually attained within a period of six months.

To accomplish these results certain principles of organization were advocated. The organization and principles were adopted and applied by the managers, and the results are shown by an extract from a letter, written by the local official ten months later.

NEW YORK, May 1, 1908.

It will interest you to know that our output for the month of April showed an increase of 69.2 per cent over the monthly average of the last fiscal year.

The average working hours are 9 per day instead of 10 as formerly. The payroll reduction is 15 per cent, amounting to $8,000 to $10,000 a month less than last year.

The same efficiency engineers were subsequently called to another plant, to investigate and to advise. In this case also their principles were accepted, their recommendations carried into effect through modified organization with the following results:

Date.	Average No. of Men.	Average Tons per Man.	Total Tonnage.	Pay Roll	Pay Roll Cost per Ton.	Increased Earnings of Men.
Sept., '08....	527	4.69	2,473	$29,380	$11.88	0 %
July, '09....	263	9.04	2,377	15,248	6.41	2 %
Aug., '09....	298	10.51	3,133	17,280	5.51	10 %
Sept., '09....	312	10.92	3,408	17,394	5.14	17.3%

It is not to be supposed that two men could come from the far west, go into eastern industrial plants, and through their own familiarity with the conditions know better how to direct them than the experienced local managers in charge. The men who came out of the west were not as well equipped with knowledge of operation or devices, were not as well acquainted with local methods and men, as the local managers, but they were far better equipped with knowledge of a new type of organization through which alone efficiency can be secured, and they had not only this knowledge but also extended and successful experience in applying it.

The difference in achievement between the modern man and the men who lived thousands of years ago is not an internal difference in quality of brain, but the tremendous external difference in conditions and equipment. The boy with the far-reaching sling knocks out the heavily armored spear-wielding giant.

It is exceedingly difficult to advocate certain principles without individuals, tribes, and nations, unable to free themselves from the personal point of view, immediately jumping to the conclusion that an attack is being made on their competency, their skill. Greek athletes could have made good records if they had had bicycles, motor cars, and aeroplanes, if they had had repeating pistols and rifles; but the arrow, however skilled the archer, does not carry as far or as straight as the rifle bullet. The principle underlying the rifle is very old—that of the blow tube—a very different principle from that of the bow and string; but the man who equips the savage with a rifle makes him more powerful than all the armored knights of chivalry, and the man who equips the modern industrial manager with a new industrial application of an old principle of organization and accomplishment, gives the mediocre manager a greater possibility of attaining high efficiency than was ever possessed even by the greatest industrial geniuses working along the old lines.*

The men from the west knew the new theories because they had applied them on a tremendous scale; they knew how to design and operate a new kind of shop control, as different from the old as the rifle is from the bow—as different as bicycle riding is from walking, flying from motoring, Arabic notation from Roman numerals. These principles in their application to shop control may not appear particularly lofty, inspiring, or even interesting

* "Two kinds of success, that of the rare genius, the other, that of the ordinary man who does ordinary things a little better than his fellows."—Roosevelt's university address in Norway.

to anyone except those whose pocketbooks are to be immediately benefited—namely, the plant owners and managers, the plant workers, and the clients of the plant; but they will evoke deeper interest when it is perceived that they are fundamental and of universal application; that in all ages lasting efficiency depended on them, and without them is always impossible; that the same principles have been applied elsewhere on a stupendous and noble scale, and that it is not men and materials, money, machines, and methods that count, but far more potently theories and principles.

We hope to arouse interest in these theories and principles and enthusiasm for them, not by sordid reference to the shop gains (although this is after all a valid ultimate test of their value) but by showing their power in recent history; and then, we can begin at the beginning and trace them up from a pre-human past into their noble work of empire building, into their not less valuable future work of industrial upbuilding.

Two of the most remarkable historical events of the last forty years are the transference of the leadership in Europe from a French Emperor to a German Emperor, the transference of leadership in the oriental North Pacific from a Chinese Emperor and a Russian Emperor to a Japanese Emperor.

As each of these startling advances was due to the same theories, organization, and principles, and as these theories, organization, and principles are equally applicable to industrial advancement, it is worth while to understand what was done and how it was done, especially as the solution of similar problems in all civilized activities is plainly the task of the Twentieth Century.

As to North and South America the Sixteenth Century was the era of discovery; the Seventeenth Century, the era of appropriation and settlement; the Eighteenth Century and the first quarter of the Nineteenth Century, the era both of making permanent what had been gained and of developing natural resources; so the Twentieth Century dawns with the as yet unaccomplished task of conservation, of eliminating wastes—wanton and wicked wastes of all kinds, wastes that make our civic governments a by-word, our destruction of natural resources a world scandal, our complacent industrial inefficiency a peculiarly national disgrace, since, of all nations, we Americans ought to know better.

It is this national inefficiency, this national wastefulness, this national squandering of current and future material, human and machine resources, that can be remedied, if we but believe and practice the plainest teachings of recent history, which are an appropriate introduction to a statement of efficiency principles and organization.

After 1850, Louis Napoleon was for twenty years the dominant figure in European politics. The British cultivated his friendship, the Italians looked to him for liberation, the Turk begged his protection, Russia was humbled by him, and Austria sought his alliance. But in the little kingdom of Prussia, about the size of Colorado, there were two men—Bismarck, the Statesman, and von Moltke the Organizer, the General—who entered into a partnership to make their king the Overlord of Europe. King William had succeeded to the throne of Prussia in 1861. He was 64 years old, imbued with all the mouldy traditions of the past, but he trusted implicitly his two advisers.

Prussia was a small, poor, second-rate power comprising about one-fourth of Germany and Austria in area and population, and it was not conceded by the balance of Germany that Prussia had any right to lead. Nobody outside of Germany cared a fig for Prussia.

There was only one way to carry out the dream of the King's two advisers. There must be:

(1) A definite plan or ideal, a standard.

(2) An organization of a form capable of attaining and maintaining the ideals through the application of principles.

(3) Equipment of men, money, materials, machines, and methods to enable the organization, through the application of principles, to attain and maintain the ideals.

(4) Leaders, competent and forceful, making the organization and equipment attain and maintain ideals.

Whether consciously or not this was but an imitation of Nature's way.

Life is the ideal; the body is the organization; eyes and ears, smell and taste, above all touch, hands and feet, teeth, clothes, houses, weapons, are the equipment; and the brain is the leader, the commander.

The two leaders whose ideals were a tremendously powerful German empire with the Prussian State and King at its head, started to create their respective organizations, military and diplomatic; they started to equip their organizations and to make them so powerful as to be able to realize the ideals. Diplomacy and intrigue were used to put each opponent in turn in a tight place, and then—the army, wherewith to crush him. We are not concerned with the diplomacy. It took great skill to provoke each quarrel at exactly the right moment, and war was brought on each time in the pleasant summer season. Von Moltke's task was however far more difficult. He could not count on having as many men, as much money, as abundant equipment, or as much material, as his opponents. It was evident to him that invisible theories and principles, which his self-sufficient opponents did not recognize until too late, would have to make up for meagre material resources, human lethargy, and awkward equipment.

The struggle, before it began, even in its first planning, was to be one of efficiency against inefficiency; of efficiency, applying to the army all the twelve principles, through a new conception and shaping of military organization.

Seconded by Bismarck, von Moltke advised the king to create the army, even though the people objected; and their very opposition served von Moltke, since, through the disregard of constitutional limitations, the King enabled him to carry into effect his theories and principles without meddlesome and incompetent interference.

To begin the great game, a quarrel with poor little Denmark was started. Austria, Prussia's great rival in Germany, was invited to become an ally in a war against Denmark in 1864. Two provinces, Holstein and Schleswig, were wrested from Denmark, Prussia occupying Schleswig, Austria occupying Holstein. This war gave von Moltke a double chance. He tried out on a small scale his own organization, and studied the weakness of the Austrian organization. In 1866 Bismarck took the next step, quarreled with Austria about Holstein, and precipitated war June 14, 1866, Prussia pitted against nearly all the rest of Germany and Austria. Prussia had at that time about 22,000,000 inhabitants, Austria and the balance of Germany 59,000,000 inhabitants. From a careful study of the American civil war, von Moltke had been learning how not to do it. Bismarck gave some of the smaller German powers twelve hours to come to terms, and then almost as rapidly von Moltke's army ate them up. Two years to a day after the Battle of Gettysburg (which occurred thirty months after the firing on Fort Sumter) the Prussians, with 225,000 men, on July 3, 1866, nineteen days after the declaration of war, defeated the Austrians with 262,000 men. In three weeks more the Austrians begged for an armistice, succeeded by a peace, which transferred the leadership of Germany, held by Austria for 600 years, to Prussia. The whole plan being a business venture in empire building, Austria had to pay to Prussia 40,000,000 Thaler (about $30,000,000), the smaller States paying in proportion; and, as the seat of war had from the start been in Austria, the cost of occupation fell in addition on the vanquished. Prussia annexed about 27,000 square miles. We fail to recall that any American industrial corporation ever showed for the same length of time as great gross and net earnings.

Napoleon III, Dictator, awoke too late. Bismarck and von Moltke were already preparing for the next step, the supplanting of the

French Emperor by a German Emperor as the war-lord of Europe.

On July 4, 1870, the throne of Spain was offered to a German prince, Leopold. This was probably part of Bismarck's plan to provoke a quarrel. Napoleon stamped his foot once too often and for the last time. The French Emperor declared war July 19, 1870. It is said that von Moltke was asleep when the telegram came, and that when awakened, he said: "You will find the plan of campaign in the third drawer of my desk," and that he then turned over and went to sleep again. This might have been true; for, from that moment, over a million men in Germany stepped, ate, filled every minute of their time, according to pre-arranged plan and schedule. They were called from their homes and private businesses everywhere throughout the kingdoms and States; all the railroads fell in line with all their equipment. There was no confusion, no hysterics, no silly haste—*"Ohne Hast, Ohne Rast."* The citizens called, found their uniforms and arms ready, provisions stored. Because the French plans contemplated mobilization in nineteen days, von Moltke had planned for eighteen days, knowing that this would place the seat of war in France, not in Germany. The French actually required twenty-one days to mobilize. They were in time 86 per cent efficient, von Moltke neither more nor less than 100 per cent efficient. In eleven days, 450,000 German soldiers were mobilized; on August 2, the first battle was fought; on August 6—only eighteen days after the declaration of war—one of the bloodiest battles occurred. On September 2, forty-five days after the declaration, Napoleon and his army, beaten at Sedan, surrendered and passed as prisoners into Germany.

What is marvelous is not that one great nation vanquished another, not that the victory came so soon, but that von Moltke's plans were so perfect that they were carried out to the day, in spite of the desperate resistance and antagonism of a force as strong as his own, both nations having about 40,000,000 inhabitants.

If it were not so tragically sad, it would be to laugh—to compare this war, planned by the master organizer of the last century, with our own inefficient, procrastinating, ignorantly managed and conducted civil war, dragging its weary and exhausting length through nearly four years, bequeathing a heritage of hate for forty years which it took a foreign war to assuage—bequeathing a stupendous pension burden, nine-tenths of it the money penalty for inefficiency.

In the American civil war each side was inspired by its own lofty ideal—the South by State rights, the North by hatred of human slavery; but neither side knew a single one of the twelve principles of efficiency, and so each side hopelessly floundered.

Von Moltke knew all the twelve principles of efficiency, and for him war was a serious business undertaking, not a frolic nor a fizzle; and because it was a business undertaking, Bismarck charged up every penny of its cost to France, presented the bills, and collected payment, $1,000,000,000, with interest added, besides taking two provinces (Alsace and Loraine) as a fair profit on a business venture.

It is not the pomp and glory of that campaign that appealed to me as I intimately and personally, both in Germany and in France, watched it from start to finish, for there was little of either; but the calm, merciless skill of the play showed me what principles could do when carried into effect by a suitable and competent organization. It was not the German soldiers who won the war; von Moltke would have won equally well had he applied his principles to Italian, Austrian, French, Russian, Japanese or Americans. The German recruits were not enthusiastic, and were below the European average in martial enthusiasm and spirit. It was not the German drill or tactics that won the war—mere methods, both long ago superseded. It was not the German equipment—mere devices—that won the war. The French *chassepot* was a better gun than the German *Zundnadel,* and the *mitrailleuse* was a better field piece than the Germans possessed. It was not German money that won the war, for France was at once far richer and had far better credit.

It was von Moltke's principles and organization that won; and a generation later the same organization and principles applied by a different race on the other side of the globe produced exactly the same fruit in very similar manner, under other able men.

Because von Moltke supplemented the old type of military organization, because he understood and applied all the twelve principles, the loss of life and limb in his wars was less than in great American industrial and railroad corporations, earning a similar amount, and never before in the world's history was so great a business venture carried through in better manner.

Bismarck died humiliated; von Moltke is no more; but their business teachings live, and the modern German Empire whose every activity puts Great Britain into a senseless panic is next to the greatest example the world has ever seen of the result of modern business principles applied to the development of a modern world power.

The greatest example of the power of rational organization and efficiency principles is not in the German upbuilding, but in the Japanese actual creation in a single generation of a great world power. In 1867 Japan was still feudal. The merchants' guild and the thieves' guild were classed together, both beneath contempt. Her peasantry was impoverished; her finest men and women, feudal dependents without initiative. When it was still a treason punishable by death, a few of the Samurai left Japan, not for wealth or amusement or conquest of any kind, but to absorb whatever there might be good in the Western civilization and to bring it back for use in their own beloved country. They conspicuously, consistently, and intelligently put von Moltke's organization into effect in upbuilding their fatherland, and also applied all the twelve principles, which they had probably independently recognized and accepted before they began their quest. In thirty years, Japan with her 40,000,000 people was able to vanquish China with her 400,000,000. In another five years, Russia, the colossus of the North, that had shattered Napoleon I—Russia, the dread of Great Britain, of France, of Germany for 90 years—went down in defeat. American sympathies were with Japan, but scarcely was the war over before the industrial organization of Japan, as much superior in principle to ours as were her army and navy to those of Russia, began to make us cry out in cowardly fear.

It is not the flesh and blood and brains of the Japanese that make them industrially dangerous; it is not their money, for they are poor, not their equipment, for they have but little, not their material resources, because they are meagre. They are dangerous as industrial competitors because we are dragging along under a type of organization that makes high efficiency possible—and they are not; because we have not even awakened—and they have—to the fact that principles applied by mediocre men are more powerful for good than the spasmodic floundering of unusually great men.

Since life began on our planet there have always been two types of organization, types that Mr. F. W. Taylor characterizes as functional and as military. The former is an organization to build up, the latter an organization to destroy.

Primitive business was so closely allied to raids, filibustering, buccaneering, slave trading (not to omit our own American Madagascar trade) that it was inevitable that the military type should be extended to business organization the world over—a type now known to be utterly unfitted to modern business conceptions and ideals. It is von Moltke's tremendous gift to the world that, although a soldier hampered by tradition, he applied to the army the other type of organization, the functional type, which ought always to have been used in business.

Because his only chance of winning the great game he and Bismarck planned lay in superior efficiency, he was forced to study all its underlying principles, and he was equally forced to adopt the only type of organization that could apply the principles; yet so invisible was it all that even his keenest enemies saw only the familiar cocked hats, epaulettes, gold lace, and dangling swords—failed to realize that without change of name or interference with rank, even for predatory purposes, the old predatory organization had passed away and been succeeded by the functional, upbuilding, accomplishing organization.

What is all the pride of achievement of the great American railroad company compared to the quiet, fore-ordained plans of von Moltke in which no hitch occurred in the supreme test?

What is the greatest American corporation as a working force, compared to the perfect organization of von Moltke, the perfect organization of the small group of Japanese leaders who have made Japan a great world power?

The British, French, German and American managers of the great industrial corporations and railroads are men of great force of character, of stupendous ability, of untiring energy, devoted to the interests entrusted to them; but because they know only empirically what the principles of efficiency are, because even empirically they apply these principles only spasmodically, the plants and railroads whose well-being they are so eager to further, are operated wastefully beyond belief. The losses in American railroad operation alone run to a million dollars a day—losses preventable through the recognition, acceptance, and persistent application of efficiency principles; losses as preventable as yellow-fever deaths at Panama, or as fuel wastes if well-designed engines, boilers and furnaces are used.

Efficiency, like hygiene, is a state, an ideal, not a method; but in America we have sought our salvation in methods.

American industrial organization, even when it has good methods, cannot use them, because the organization, inherited from antiquated British models, is so defective in theory as to make an application of the principles as well as of good methods impossible.

In this chapter we have attempted to show that conditions of extreme inefficiency in shops as well as in empires can be converted in a very short time into states of high efficiency; that the prime instruments for efficiency in the examples cited were not men, materials, money, machines, and methods, but theories of organization and principles; that inefficiency prevails in all American activities because the type of organization is one that does not lend itself to the application of efficiency principles; that the hope of rapid improvement lies in so amending or supplementing the usual type of organization as to make it possible to apply efficiency principles.

The next chapter will outline and contrast the two types of organization, and will show why one is not adapted to secure efficiency, and why the other one is.

II

THE TYPE OF ORGANIZATION THROUGH WHICH EFFICIENCY IS ATTAINED

Go to the ant, thou sluggard; consider her ways, and be wise.—*Proverbs*, 6, 6.

Consider the lilies how they grow: they toil not, they spin not; and yet I say unto you, that Solomon in all his glory was not arrayed like one of these.—*St. Luke*, 12, 27.

Chapter II

THE TYPE OF ORGANIZATION THROUGH WHICH EFFICIENCY IS ATTAINED

THE poor white trash of the southern States and the listless negroes have long been a by-word, but we suddenly find out that all these people, white and dark, are afflicted with a parasite, the hook-worm, which saps their vitality, internally slowly bleeds their strength away.

The remedy is not schools, nor churches, nor the suppression of the saloon, nor the sternness of the task-master—all excellent devices; the remedy is the elimination of the parasite. After this initial betterment, the principles of education, of religion, of temperance, of stimulus, may be confidently applied.

American organization for operation, whether governmental (army, navy, civil), whether state or municipal, whether for land-railroads or ocean-steamboats, whether educational or religious, whether industrial or commercial, proves on investigation to be inefficient, often disgracefully so, the efficiency of the output of men of militia age of the country as a whole being not more than 5 per cent, the efficiency of use of materials being not more than 60 per cent, the efficiency of equipment facilities not averaging 30 per cent. These inefficiency statements can be verified from the facts, by any competent experts, as readily as an assayer can duplicate the assay of an ore sample.

Our material resources are unsurpassed, our workers are intelligent, ambitious, versatile, our equipment, from farm lands to office buildings, from typewriters up to Mallet compounds and down again to telephones, is lavish; yet it is all depreciated by an equally stupendous inefficiency. The principles of efficiency are simple, are plain, are elementary; they have been accepted and practiced empirically for a few million years since life began on our planet; yet in modern America, we flounder in our productive operations, as hopelessly put back in the running as the hook-worm victim in the South.

What is this insidious disease that wastes our resources of materials, of human potentiality, of equipment—that prevents the application of efficiency principles even as the existence of the hook-worm prevents the application of principles of human well-being?

The industrial hook-worm disease is defective organization.

In the first chapter of this book I have shown that a certain type of organization, whether applied to the development of empires or to industrial shops, produces very high efficiency. There is another type of organization, unfortunately the one almost universally adopted in our collective activities, which is incapable of applying efficiency principles; and the use of this type is responsible for much of modern inefficiency and waste. An air compressor, forcing hot and squealing air, and a vacuum pump softly coaxing cooling air, are one and the same machine working on the same cycle in opposite directions. With a few simple changes the compressor can be changed into the vacuum pump. So with a few very small changes a disastrous form of organization can be turned into a beneficent form. We shall try to make clear the difference between these two forms of organization, to show why it is impossible for one type to apply efficiency principles and impossible for the other type not to apply them, to show that from the beginning of life the efficient type has always produced better results, and that a long step forward toward conservation will have been taken when we adopt for our collective life the superior type; to show that the change from one type to another is radical only in theory, not in operation —not at all such a change as substituting electric traction for steam traction, a prohibitively costly undertaking; much more such a change as substituting a north window with its mellow diffused light for a south window with its fierce glare and shadows.

In primitive times, with that fatuity and perversity which unaccountably characterizes so much that is human, we turned to the left when we ought have turned to the right. Having two forms of organization to choose from—only two, the destructively offensive and the constructively defensive—we chose for our industrial organization the destructively offensive type, and it does not work out, never can and never will; while we ought to have chosen the constructively defensive type of organization, alone suited to the processes of productive upbuilding.

The two types of organization are as old as life, are therefore far older than humanity, and we have had to accept them as part of our inheritance just as we accept the necessity of assimilation, of elimination, of reproduction, of breathing. But there is no more reason in adhering industrially to the destructive type of organization, since we have learned that the other is better, than there is in adhering to pack teams and ox carts after the railroad and automobile have been perfected.

To bring out clearly the radical differences between the two types of organization, in spirit, in effectiveness, and in methods, we select two primitive examples, one a plant and the other an animal. The plant trusts to the generous, often enthusiastic, co-operation of forces outside of itself and it therefore draws strength of wide and unlimited range. The mammal trusts to the occasional, often grudging, co-operation of powers identical in kind with its own, therefore of limited scope. The pathfinder through primeval forest is impressed with the luxuriant wealth and profusion of plant life—trees, at their best, 400 feet high; is impressed with the comparative paucity, pettiness, transitoriness of animal life, whose largest jungle representative is the elephant, twelve feet high and living at most a few hundred years. Plants trust all nature and draw help from everywhere; animals trust none but their kind and grow through destruction. Even that type of all that is silly and innocent, the sheep, will destroy in a few years a millennial pasture range.

The wild rose-bush exemplifies the defensive, upbuilding type, of organization. The rose stems are covered with sharp thorns so that the delicate flowers may not be plucked and destroyed by wanton creatures who might just as well be browsing on grass or leaves, but the color and perfume of the blossoms attract the bees, beetles, butterflies, and moths who in return for an efficiency reward, the honey, cross-fertilize the plants. The petals fade and drop, the seed receptacle, an inconspicuous green, swells and grows. When ripe, the leaves that hid it fall away; it appears red, a tempting rose-apple to bird that plucks it, to mammal that finds it dropped, but the cradle of the seeds is so protected that the rose babies escape to grow and flourish where they fall. The rose relies on defensive up-building organization, calling on water, air, warmth and light, earth, insects, birds and mammals, each taking a part, all helping the rose to dot the western prairies, to deck the roadsides and moors of the New England seaboard, to blanket the lovely North Pacific coast.

Roosevelt gives us the other picture when he describes the African baboons who are organized for offense, for destruction:

> The baboons were very numerous around this camp, living both among the rocks and in the tree-tops. They are hideous creatures. They ravage the crops and tear open new-born lambs to get at the milk inside them; and where the natives are timid and unable to harm them they bacome wantonly savage and aggressive and attack and even kill women and children. In Uganda, Cunninghame had once been asked by a native chief to come to his village and shoot the baboons, as they had just killed two women, badly bitten several children, and caused such a reign of terror that the village would be abandoned if they were not killed or intimidated. He himself saw the torn and mutilated bodies of the dead women; and he stayed in the village a week, shooting so many baboons that the remainder were thoroughly cowed.

Baboons do not act singly, but in bands with leaders, with sentinels posted. Baboons, wolves, wild dogs and primitive man are thoroughly organized for offense and destruction. It is because the object is offense and destruction that evil characteristics are most prominent—arbitrariness, irresponsible exercise of power, harshness, cruelty, with anarchy all along the line.

Some strong male, differing not in kind but merely in degree from his fellows, has fought his way to the top, is given allegiance, based partly on fear, partly on self-interest. He delegates power, or each lower rank of followers usurp power, and this results in anarchy all along the line. Are we now writing of the African baboons, of the wolf pack, of the paleolithic war chief, of the neolithic hunting, foraging, plundering, filibustering chief, of the enterprising New York Madagascar trader, of the respectable Rhode Island slaver and rum trader and privateer; or are we writing of Roosevelt's land and marine experiences as a Rough Rider with our army and navy; or are we writing of the shops of the great industrial incorporations, of the operation and maintenance of our railroads? It is all one and the same thing, as they all are victims of a common type of organization resting on the same principles—individual arbitrariness at the top, usurped and delegated power down the line, anarchy everywhere.

Modern men have lost the fangs and the cruel hands of the baboon; in them also his savage, cruel instincts are softened. Modern sea captains are not such monsters of cruelty as Henry Morgan, modern generals are not as ruthless as Caesar, Attilla, Jenghis Khan, Tilly, or even Napoleon. Men, thoroughly good, conservative, upright men, with every great upbuilding instinct, are happily at the head of most of our great institutions; they are infinitely better than the destructive organizations through which they are compelled to work, knowing no other; but the old danger is always latent. We who know could fill volumes with modern illustrations of the ever outcropping evils due to the destructive type of organization.

Let all who wish to become acquainted with a detailed story of humiliating inefficiency, due to arbitrary incompetence—at Washington, mitigated by usurped power and anarchy everywhere, read of the difficulties with which a great and resourceful leader had to cope even in the oldest and most perfected type of offensive organization, the military:

The battalion chief of a newly raised American regiment, when striving to get into a war which the American people have undertaken with buoyant and light-hearted indifference to detail, has positively unlimited opportunity for the display of "individual initiative." . . . . . If such a battalion chief wants to get anything or go anywhere he must do it by exercising every pound of resource, inventiveness, and audacity he possesses. The help, advice, and superintendence he gets from outside will be of the most general, not to say superficial, character. He will have to fight for his rifles and his tents and his clothes. He will have to keep his men healthy, largely by the light that nature has given him. When he wishes to embark his regiment, he will have to fight for his railway cars exactly as he fights for his transport when it comes to going across the sea; and on his journey his men will or will not have food, and his horses will or will not have water and hay, and the trains will or will not make connections, in exact correspondence to the energy and success of his own efforts to keep things moving straight.

It was on Sunday, May 29, at San Antonio, Texas, that we marched out of our hot, windy, dusty camp to take the cars for Tampa. There were no proper facilities for getting the horses on or off the cars, or for feeding or watering them; and there was endless confusion and delay among the railway officials. The railway had promised us a forty-eight hours' trip, but it was four days later that we disembarked, in a perfect welter of confusion. Everything connected with both military and railroad matters was in an almost inextricable tangle. There was no one to meet us or tell us where we were to camp, and no one to issue us food for the first twenty-four hours; while the railroad people unloaded us wherever they pleased, or rather wherever the jam of all kinds of trains rendered it possible. We had to buy the men food out of our own pockets, and to seize wagons in order to get our spare baggage taken to the camping ground which we at last found had been allotted to us. . . . . .

It was the evening of June 7 when we suddenly received orders that the expedition was to start from Port Tampa, nine miles distant by rail, at daybreak the following morning; and that if we were not aboard our transport by that time we could not go. We had no intention of getting left, and prepared at once for the scramble which was evidently about to take place. As the number and capacity of the transports were known, or ought to have been known, and as the number and size of the regiments to go were also known, the task of allotting each regiment or fraction of a regiment to its proper transport, and arranging that the regiments and the transports should meet in due order on the dock, ought not to have been difficult. However, no arrangements were made in advance; and we were allowed to shove and hustle for ourselves as best we could, on much the same principles that had governed our preparations hitherto.

We were ordered to be at a certain track with all our baggage at midnight, there to take a train for Port Tampa. At the appointed time we turned up, but the train did not. . . . . .

We now and then came across a Brigadier-General, or even a Major-General; but nobody knew anything. Some regiments got aboard the trains and some did not. . . . . . At six o'clock some coal cars came by and these we seized. By various arguments we persuaded the engineer in charge of the train to back us down the nine miles to Port Tampa. . . . . .

The trains were unloading wherever they happened to be, no attention whatever being paid to the possible position of the transport on which the soldiers were to go. Colonel Wood and I had jumped off and started on a hunt, which soon convinced us that we had our work cut out if we were to get a transport at all. From the highest General down, nobody could tell us where to go to find out what transport we were to have. . . . . . The quay was crammed with some ten-thousand men, most of whom were working at cross purposes. . . . . .

The military attachés came out to look on—English, German, Russian, French and Japanese.

We were allotted a transport—the "Yucatan." She was out in midstream, so Wood seized a stray launch and boarded her. At the same time I happened to find out that she had previously been allotted to two other regiments — the Second Regular Infantry and the Seventy-first New York Volunteers, which latter regiment alone contained more men than could be put aboard her. Accordingly I ran at full speed to our train; and, leaving a strong guard with the baggage, I double-quicked the rest of the regiment up to the boat, just in time to board her as she came into the quay, and then to hold her against the Second Regulars and the Seventy-first, who had arrived a little too late, being a shade less ready than we were in the matter of individual initiative. There was a good deal of expostulation, but we had possession; and as the ship could not contain half of the men who had been told to go aboard her, the Seventy-first went away as did all but four companies of the Second. . . . . . The transport was overloaded, the men being packed like sardines, not only below but upon the decks; so that at night it was only possible to walk about by continually stepping over the bodies of the sleepers. The travel ration which had been issued to the men for the voyage was not sufficient, because the meat was very bad indeed. . . . . . The soldiers were issued horrible stuff called "canned fresh beef." There was no salt in it. At the best it was stringy and tasteless; at the worst it was nauseating. Not one-fourth of it was ever eaten at all, even when the men became very hungry. There were no facilities for the men to cook anything. There was no ice for them; the water was not good; and they had no fresh meat or fresh vegetables. . . . . .

By next morning came the news that the order to sail had been countermanded, and that we were to stay where we were for the time being. What this meant none of us could understand. It turned out later to be due to the blunder of a naval officer. . . . . .

Meanwhile the troop ships, packed tight with their living freight, sweltered in the burning heat of Tampa Harbor. There was nothing whatever for the men to do, space being too cramped for amusement. . . . . . So we lay for nearly a week, the vessels swinging around on their anchor chains, while the hot water of the bay flowed to and fro around them and the sun burned overhead. At last, on the evening of June 13, we received the welcome order to start. . . . . We knew not whither we were bound, nor what we were to do. . . . . . We had a good deal of trouble with the transports. . . . . . One of them was towing a schooner, and another a scow. . . . . .

We rolled and wallowed in the sea-way, waiting until a decision was reached as to where we should land. On the morning of June 22 the welcome order for landing came.

We did the landing as we had done everything else—that is, in a scramble, each commander shifting for himself. . . . . . There were no facilities for landing, and the fleet did not have a quarter the number of boats it should have had for the purpose. . . . . . Meanwhile, from another transport, our horses were being landed, together with the mules, by the simple process of throwing them overboard and letting them swim ashore, if they could. . . . . . One of my horses was drowned. The other, Little Texas, got ashore all right. While I was superintending the landing at the ruined dock with Bucky O'Neill, a boatful of colored infantry soldiers capsized, and two of the men went to the bottom; Bucky O'Neill plunging in, in full uniform, to save them, but in vain.—Abbreviated from ROOSEVELT'S *Rough Riders*, Pages 47-71.

Mr. Roosevelt has always been the apostle of strenuousness. Strenuousness and efficiency are not only not the same, but are antagonistic. To be strenuous is to put forth greater effort; to be efficient is to put forth less effort. To walk four miles an hour is efficient, but not strenuous; to hustle along at six miles an hour is exceedingly strenuous, but not efficient, since an hour or two of the pace would exhaust the walker and indeed incapacitate him for further progress.

To increase speed by using a bicycle is efficient. Six miles an hour on a bicycle is so easy that it is neither strenuous nor efficient. Ten miles an hour is efficient but not strenuous; twenty miles an hour is exceedingly strenuous but not efficient, since it overtaxes the man.

The barn-yard rooster when chased from his dung-hill flutters strenuously but not efficiently. The eagle soaring for hours in the sunlight without flapping a wing is efficient but not strenuous. Efficiency brings about greater results with lessened effort; strenuousness brings about greater results with abnormally greater effort. Piece rates are based on the theory of strenuousness; standard times and bonus are based on the theory of efficiency. The difference between the two is philosophic and physiological. Piece rates are a reversion to savage standards; standard times are a step into the future, even as the scheduled train is an advance over the bringing of the news to Aix, or Paul Revere's or Sheridan's ride.

The efficiency engineer meets everywhere the inefficiencies, losses, ravages, disasters, material and moral, always latent, often active in wrong organization. To illustrate by instances from experience:

The able president of a two-hundred-million-dollar corporation, hearing that piece work resulted in greater output than day work, ordered piece rates put in and made the basis of remuneration on a few days' notice. A disastrous strike followed, costing the corporation $2,000,000, the community being made to suffer from violence of all kinds by strikers and their sympathizers, by officials and their hirelings. This president would not have presumed to design a steam engine, perhaps not have presumed without advice to select a typewriter; yet he rashly acted on two of the most delicate problems that confront any modern corporation, *wages* and *efficiency reward.* He did not know that efficiency reward ought to be preceded by the careful, systematic, and expert application of eleven other principles, of which "Wages" is a minor element of one; he did not know that the eleven anterior principles were largely lacking in application in his company, and that conditions were not ripe for any form of efficiency reward; he did not know that even if his company had been fitted to adopt the principle of efficiency reward, it remained a momentous question as to what form should be used, piece rates being probably the last that a competent expert would recommend. He was not to blame. He had to make a decision, and he did not have an organization around him, over him, under him, that automatically prevented this mistake, equally disastrous to his company, to his employees, and to himself.

The general superintendent of one of the of the largest American industrial plants, tremendously successful through his great genius, power, ability, told me with pride that for five months he had refused to allow any shop tools or supplies to be bought. He boasted that a smith foreman, failing to secure on requisition flatter steel, had made flatters out of Krupp steel tires which he appropriated for this purpose. The tool account came down, it is true, but at what cost in man-wasted time with smooth files, and all other man-supply deficiencies—in diminished output from machine-wasted time due to defective belts and all other machine-supply deficiencies?

Industrial arbitrariness by the superintendent, delegated and usurped power in the foreman, anarchy all along the line!

There are more disgraceful examples that could be cited in which foremen plundered and swindled the men under them, debauched wives, violated homes, because the power to employ and discharge, to promote and reduce, to augment and to lower compensation, had been delegated to them. American trade unionism, with all its imported tenets of inefficiency, is in large part a justifiable collectivism, alone able to cope with some of the worst outrages to which individual wage earners have been exposed; and it is pathetic that these same wage earners, in resorting to unionism, have known no better than to adopt all the worst characteristics of that form of organization against the evils of which they were rebelling.

A high American railroad official of great and long experience told me that no grievance committee of wage earners had ever come to him with what seemed unreasonable and unfair demands that he had not been able to find as the original incentive to its action the arbitrary injustice and tyranny of some insignificant local official, foreman, or boss.

I have intimately watched the inception, progress, and end of three railroad strikes. Twice they were precipitated by the arbitrary action of irresponsible, yet conscientious and able railroad officials. The money lost in these two strikes by the employing companies was sufficient to establish efficiency operation on every American railroad, and under efficiency operation strikes are inconceivable. The third road won its strike hands down because it spent for defense, preparation, and mitigation of evils, one-tenth the sums necessary in the other cases for war and destruction.

In American organization a successful man becomes president, he selects his staff, his cabinet and—he puts it up to them. Each in turn selects his staff of managers and—puts it up to them. The manager selects his superintendents, and passes the power and responsibility on to them. The superintendent selects foremen, and delegates to them the power "to make good." The foremen select their workmen, and transmit to them the power to do the thing the president really wanted done.

The man at the bottom, with the least spare time to plan, the least training, the least compensation, runs the whole affair. This is the type—so usual, so universal, that many will show amazement that it is questioned. It is the baboon, the wolf-pack, type of organization and it is all wrong.

The wild rose, relying on allies outside of itself to aid it, has developed and flourished under the defensive up-building type of organization, but we need not go so far afield. Plant life has no monopoly of upbuilding organization. Among the baboons, among the wolves, among the foxes, among men, the defensive, the up-building type of organization also exists, but men have not applied it to business. In his family life, and he is a most worthy husband and father, the fox imposes maternity on his vixen companion. This is no delegation of power, for he is incapable of maternity. He imposes a duty and assumes a tremendous responsibility, and—he gives the balance of his life to doing his part that she may make a full success of what he imposed on her. He protects, he provides, he feeds her, he watches over her. The organization is one for defense and up-building, and without it life would perish from our planet. The vixen in turn imposes on her young the greater duty of life, but in so doing she assumes a crushing burden of obligation toward her offspring. She feeds them from her own body, she watches over them, she trains them and teaches them, and, if need be, gives her life for them. She delegated nothing, but she imposed obligation and she gives the balance of her life that they may make a full success of what she unwittingly imposed on them.

That the race of foxes may endure forever, the vixen exists for the sake of her babies, not they for her; the father fox exists for the sake of the vixen and her special task, not she for him.

There is, of course, authority running from top to bottom, authority commensurate with responsibility, greater and stronger authority than that inspired by fear, but though the cubs obey the mother and the father, the organization is one of defense, of up-building.

This is the type of organization von Moltke imposed on a Prussian army. He left apparently intact the predatory form; but he created *staff*, and though it was an elementary and inadequate staff it made his stupendous achievements possible. Von Moltke realized that there were natural laws superior to any general orders of his, that the general orders would be effective in exact degree as they utilized natural laws to the best advantage. He therefore created a general staff of specialists, officers, students, experts, acquainted with and skilled in the knowledge of general laws, and it was with their knowledge that he outfitted his armies, planned his campaigns, and executed his designs. The plans of his general staff prevented the issuance of orders contrary to the laws of nature; it stimulated the issuance of orders in accordance with the laws of nature; just as effectually as wheel flanges keep locomotives on the track and as steel rails lessen wheel friction, so there was elimination of futile waste, the promotion of efficiency. It required no revolution, no tearing down of what was, to change offense and destruction into defense and construction. Bismarck's main aim was not to conquer Austria or France, but to build up Prussia and Germany, and an army with a new organization was the instrument.

The stone, spear or sword was distinctly an adjunct to primitive man, but just as distinctly modern man is an adjunct to the machine tool, to the locomotive, to the twelve-inch gun. We would use them automatically if we could, and dispense with the man, even as we now drill oil and gas wells two-thousand feet deep and dispense with a well digger. Having reversed the relation of worker to his tools, we must of necessity reverse the relation of officer to private, of official to employee; we must reverse the administrative cycle. The employee no longer exists merely to aggrandize and extend the personality of the employer, but the latter exists solely to make effective the totally different function of the employee.

Modern industry as distinguished from primitive industry is run with equipment. It is the locomotive that pulls the train, the car that carries the freight. They are there for this purpose; this is the inspiration of their design, construction, operation and maintenance.

We would willingly dispense with the locomotive-engineer and fireman if we could; they are capable of something better than watching signals and shoveling coal. The only excuse for putting human beings on such work is that the equipment used still requires human supervision. Similarly, in the shop, the equipment and its purpose are the main considerations and the duty of the machinist is primarily to his equipment. As we rise in the line we find each higher grade legitimately existing solely for the benefit of what is below, not for the amusement of what is above. The foreman is there, not to relieve the superintendent of responsibility, but to direct the men on the machines operating to repair the locomotives pulling the freight. The general manager is there for the sake of the superintendents, the vice-presidents are there for the sake of the managers and the president is there for the sake of the vice-presidents.

Ideals may have been imposed or have been conceived by the president—the plan, perhaps, to develop a continent. The instrument used is a corporation, whose efficiency reward is dividends earned by carrying freight and passengers. These ideals of development, of earning capacity, remain; but to carry them out natural laws must be observed, these laws being efficiently taught by those qualified by study and experience to teach and direct. The laws are applied by officials each of whom is servant to the men over whom he has directing control. In vain does president or vice-president, manager or superintendent, issue orders and delegate power under current organization. Knowledge and ability, desire and interest, become diluted with every spreading step.

It is within my knowledge that the able, conscientious, and indefatigable chief engineer of the greatest constructive enterprise the world has ever undertaken was advised that the efficiency was very low, not aggregating much over 50 per cent, and of the remedies. He was offered, free of charge, efficiency staff advice. He did not avail himself of this offer because he belonged to the old school, because he did not know that standards could be established, much less realized, although in sanitation he accepted fundamental organization and authority; and so the actual results under him are costing two hundred million dollars more than they should have cost if he had been von Moltke, if he had had von Moltke's conception of modern organization.

With millions of flowing details, each separately elusive as one among millions of buzzing insects, the task seems hopeless and staggers us by its immensity, until we remember that honey bees, the most independent of union workers, have, as a union, gratefully accepted efficiency administration; that deleterious mosquitoes have been suppressed at the Isthmus of Panama by preventing their birth; that the task of modern organization is to control millions of details through a staff of specialists who supplement each working unit from tool, machine, implement, up to president and to corporation.

The central part in railroading is the locomotive. The one essential for a locomotive is to stay on the track. This is an absolutely modern conception. There was no such idea in the centuries of the pyramids, nor even in the days of Napoleon and of Robert Fulton.

Because it is modern, an organization has been created to see that it works. One might evolve the operation of a modern railroad from the wheel flange. The presidents and their staffs dictate a few letters each day, perhaps a hundred thousand in all; but that rails may stay in place and resist the side pressure of the wheel flange, two-thousand five-hundred million spikes are inspected every day by the humble track walker, and though the train runs under the supreme control of conductor, of engineer, of fireman (as much as the dray runs under the control of its driver) the difference lies in the fact that all the departments of track maintenance, of equipment maintenance, and half the operating department, exist solely for the purpose of moving the wheels on the rails, of transmitting safely 2,600 horse power through six half-inch squares of frictional contact.

This is a stupendous result empirically achieved, since as yet but little has been standardized as to either track, motive power, equipment, or operation, and no cost efficiency standards have ever been theoretically established as possible ideals.

The defective wolf-pack type of organization which still controls American railroads, American industrial plants, is one in which a chief issues arbitrary orders to his subordinates expecting them somehow or other to execute them. The perfected organization for industrial upbuilding and efficiency is one in which specialists formulate the underlying principles, instruct as to their application, and relentlessly reveal both their observance and neglect.

It is of minor importance how the knowledge and experience of specialists is made available for the control and guidance of all line officials. Independent accounting firms impose their checks on even the greatest corporations. Independent efficiency specialists might well impose more profitable and important checks on the greatest corporations. The same end might be attained from an efficiency engineer, advised by an efficiency board, holding a position of efficiency authority on a president's staff, even as comptrollers hold positions of authority as to accounting.

Accounting, however accurate and minute, cannot of itself bring about efficiency. Its ideals are charges, credits, and balances, with authority for either charge or credit. The only standards it can possibly set up are those of former attainment, the only inefficiency it can point out is the failure to realize a former attainment. Accounting is unable either to set or attain ideal standards. Yet no modern business presumes to run without some kind of accounting. This is embryonic recognition of the need of staff regulation. Accounting in all its phases is a minor division of one of the twelve efficiency principles, *trustworthy, immediate and adequate records.* The eleven other principles are none of them less important than records, some of them more important.

A modern undertaking of any kind will be prepared to operate efficiently when each minute operation can attract to itself all the required knowledge and skill in the universe. It is only through a qualified staff, applying as needed to every detail the twelve principles of efficiency, that we can build up from the bottom instead of futilely dictating from the top.

How, practically, should this staff be formed and made effectively operative? No patent medicine exists that is a universal tonic for all forms of debility. No two organizations are alike, either in their merits or in efficiencies, and the object of staff is to provide what is missing, whether in organization, recognition of efficiency principles, or their application.

It is evident that there ought to be a controlling efficiency engineer, even as there is a comptrolling accountant or auditor. The comptroller as to accounts acts as a funnel into which is drawn all the best experience of the world as to accounting, and after filtration it is carried authoritatively down the line and applied where needed. A competent librarian acts as an intermediary between all the knowledge of the universe collected in books, and the great miscellaneous reading public seeking information. An efficiency engineer ought similarly to act as a funnel, being equipped to gather from all available sources whatever is of operating value for the organization he is advising.

Just as it is the business of the comptroller to apply accounting principles, so is it the business of the efficiency engineer to apply to all operations the twelve principles of efficiency. The duty of the executive desiring efficiency, who has accepted the defensive, upbuilding type of organization by appointing an efficiency chief, is not to demand details but to demand a certain efficiency—whether 80, 90, 100 or 110 per cent—and he should make himself sufficiently familiar with the twelve efficiency principles to apprehend their bearing on ultimate efficiency, thus qualifying himself to second and make operative the plans of his expert. If he waives the attainment of any definite excellence, he may set up his own limiting standards as to each of the twelve principles and instruct his efficiency engineer to accomplish what he can under the limitations imposed. Everybody knows that a horse trotting a mile in two minutes can be secured, and that the mile will be trotted in this limit if every condition required for success is provided. On the other hand, a wagon may be loaded with 5,000 pounds, a mile measured over a bad road, and the horse and driver told to do the best they can. They may do well, but it will not be a two-minute performance.

In industrial operation, a whole plant—a whole railroad, for instance—can be brought up to the highest practicable efficiency if the principles are applied by a master mind, using a properly equipped organization. Even a Napoleon forced to use a defective organization and emasculated principles can attain at best mediocre results. An incompetent head, if supplemented by a perfect organization, will often do little harm, as has so often been shown in the progress of England under some no-account kings.

An inferior leader, however. relying on defective organization, without ideals, is bound to go down in defeat and to drag down with him all he controls.

III

THE FIRST PRINCIPLE: CLEARLY DEFINED IDEALS

Life's just a matter of farming—of finding fertile soil in a good field—of breaking ground and being patient. The harvesting comes last—the main work must be done while the least results are showing.—HERBERT KAUFMANN.

Make your chart before you start. Know what you're after before you start out for it. — HERBERT KAUFMANN.

Each wakening song and glint of green
  And Earth's new blossom crieth: "See,
Life's measure is not what hath been,
  But what may be!"

CHARLES BUXTON GOING.

He only seems to me to live and to make wise use of life who sets himself some serious work to do and seeks the end of a task well and skilfully performed. —SALLUST.

If a man does not know to what port he is steering, no wind is favorable to him.—SENECA.

CHAPTER III

THE FIRST PRINCIPLE: CLEARLY DEFINED IDEALS

ASSUMING an organization adapted to their application, it will be found that efficiency principles, although all interrelated, all necessary to each other for highest results, nevertheless stand in a logical sequence.

The first principle is *a clearly defined ideal.*

In the earlier days of American manufacturing and transportation development, a century ago, a bright young journeyman who started out to manufacture some special line was very definitely aware of what he intended to make and how the work was to be done. He knew what he wanted. At the present time, in large plants men succeed to authority by transfer or by promotion and are very often without definite conceptions of the purposes for which the plant is working. Workers and foremen at the lower end of line organizations are so far from the "Little Father" or from the "Big Stick" who dictates all policies, who alone is responsible for organization, for delegation of power, and for supervision, that they are driven to create minor ideals and inspirations of their own, these being often at variance with the ideals of those above them. If all the ideals animating all the organization from top to bottom could be lined up so as to pull in the same straight line, the resultant would be a very powerful effort; but when these ideals pull in diverse directions, the resultant force may be insignificantly positive—may, in fact, be negative.

This condition of subsidiary deleterious and conflicting ideals is very common in all American plants, as well as great vagueness and uncertainty as to the major ideal, even among the higher officials, as we shall try to show by various examples which could be duplicated by every experienced manager in the country.

A handy man in a railroad repair shop examined cylinders for cracks. These were often so unimportant that they could be safely repaired by a patch, but in other cases a new cylinder had to be ordered. A patch may cost $30, a new cylinder $600. The handy man swelled with pride when his recommendation for a new cylinder was heeded. He boasted to his wife and fellows of the confidence placed in him and the importance of his work. When in doubt, he reported always in favor of a new cylinder; and it was easier to accept his recommendation than to institute a separate revisional examination to be made by a man scarcely better qualified. The ideals of economy and promptness were submerged, and the conflicting ideal of individual aggrandizement substituted.

A large plant was filled with machinery for turning out work. Some of these machines were automatic and some hand-operated. The automatic had been introduced to lessen expenses and delays. The superintendent of the department was an ardent patriot and churchman; not a man was employed by him who was not recruited from his own nationality and church. He had installed piece rates, singularly inappropriate, since volume of work fluctuated suddenly between wide limits. When work fell off, instead of doing it all on the automatics, he shut these down, and had it all done by hand so as to give employment to his piece workers. His ideals were not *"best product in shortest* *time at least expense,"* but *"largest amount of employment and reward to fellow-countrymen and co-religionists."* This superintendent being unsupplied with ideals by the management, had created his own.

In another plant twenty-four men were working in the tool room. This was an excessive force, and the specialist in charge of tools allowed it gradually to shrink through resignations to eighteen men. Suddenly six new men reported for duty in the tool room, engaged by the general foreman. When the specialist interviewed him on the subject he stated: "My allowance for tool room is twenty-four men. If I get along without this number my allowance may be curtailed. Later when I need the men I may not be able to secure them. I propose to maintain the allowance whether there is work or not." It took a long time to convince this foreman:—

First, that twenty-four men were not needed.

Second, that if scheduled work made fifty men necessary he could have them.

Distorted ideals placed him in antagonism to the main purpose of the management.

In another plant, a general superintendent was very averse to any reduction of men below one thousand. He was anxious to turn out more work, was willing to curtail hours of the thousand employed, but to fall below one thousand, even though they voluntarily dropped out, seemed to him to be lowering his own rank since he had worked for years to reach the position of superintendency over a thousand men. Economy, efficiency, were all waived on account of a perverse ideal—personal pride.

The general superintendent of a plant employing twelve-thousand mechanics was firmly convinced that the only way to turn out a large volume of work was to employ more men. He seemed to think that men could be piled into one side of the balance scale and volume of work into the other and that men would pull up the work by their gross weight. On one occasion he sent out an order that economy was not the object, but the production of output, and that the force was to be increased to the maximum. He ran up expenses $500,000 in five months and raised his unit costs far above what they had been, far above those of his competitors, far above what they retreated to when he was relieved of authority. A false numerical ideal worked at contrary purposes to true efficiency ideals.

The president of a great industrial corporation authorized standard-practice policies, then entered into contracts with clients on the basis of material, direct labor, and a percentage on direct labor. When it was pointed out to him that increased efficiency would mean fewer hours of direct labor, therefore less pay and less percentage for the same work, he promptly solved the difficulty by relieving the standard-practice advisor from the duty of offering further unpalatable advice, and by forbidding the application of efficiency methods to the shop in question.

In the early days of railroad construction all over the world, false conceptions and ideals greatly increased cost and left a legacy of inefficiency that centuries may not be long enough to obliterate.

The British engineers set up such high standards of grade, curvature, and double tracking, together with such low standards of clearance, as to double the initial cost of all British roads and curtail forever their capacity.

It is told of King Louis I of Bavaria that when he took his initial ride on the newly constructed first rail line in his kingdom, he expressed great disappointment that there was no tunnel, so the line was relocated and made to run through a hill.

Emperor Nicholas of Russia when deferentially asked by his engineers how the line was to be located between St. Petersburg and Moscow, took a ruler and pencil and ruled straight lines between the two cities. "That is the location, gentlemen!" It cost $337,000 a mile, the distance about 400 miles. The railways in Finland, where staff advice was heeded, cost $23,000 a mile.

Americans feel like smiling scoffingly at these mistakes, but was this arbitrary action any worse than that of a Secretary of the Navy who, without investigation and in spite of remonstrance by the naval board of construction, ordered the "Texas" built exactly according to the discordant purchased plans for two different vessels? No wonder the "Texas" was always a monstrosity! But it has at last served a really useful end under the name "San Marcos" in being used as a target to test the accuracy and power of the big guns on the newer battleships.

What also shall we think of that American transcontinental road which having a water level between two points, 384 miles apart, deliberately abandoned the water level and put in 2,500 feet of mountain climbing and as many of descent between the same points, the officials after all failing to secure from a little western city the bonus for which they had sacrificed good location for all time.

In all these instances, from handy man with cracked cylinder to king, emperor, or knave ruling a railroad location, there is a definite ideal, however bad, consistently pursued; and when these ideals stand in dependent sequence, the result becomes exceedingly costly. The handy man orders a $600 cylinder instead of a $30 patch; his foreman, wishing to employ as many of his church members as possible, has the cylinder made on an inferior machine, with high piece rates; the general foreman fills the tool room with unnecessary men who become busy doing useless work at heavy expense in materials and overhead expense; the shop superintendent is content as he sees the men under him pass the one-thousand mark and joyfully acquiesces in the general superintendent's order to add fifty per cent to the force. Under this sequence, the making of an unnecessary $600 cylinder becomes almost a necessity and the handy man is promoted on account of his skill as a work provider. The 2,500 feet of mountain grade makes many additional locomotives necessary, so there are many more opportunities to make new cylinders instead of patching old ones.

These are examples of the cankering effect of low or lateral ideals, but perhaps even greater loss results from vague ideals and from personal impulse.

At the siege of Sebastopol the officers at dinner in the wardroom of a man-of-war were astounded to hear the big siege gun boom several times, with explosions of midshipmen's laughter afterward. Each firing of the gun cost $250. Investigation showed that bets were up between the middies as to which one could make a donkey move in the public square, and each was taking a shot in turn—with no damage to the donkey.

An engineer poured onto the ground a gallon of 40-cent oil in order to have the tinsmith solder a leak in a 15-cent can. A railroad track foreman and gang were recently seen burying under some ashes and dirt a 30-foot steel rail. It was less trouble to bury it than to pick it up and place it where it could be saved.

A young engineer in railroad service started out to spend some $750 for photographic apparatus, evidently laboring under the impression that if he only spent money enough he could overcome personal, meteorological, optical, and other limitations to good work.

The superintendent of a plant ordered a large automatic lathe to make crank pins from the solid bar. He had no ideals of his own, but vaguely felt that an automatic lathe ought to do cheaper work. When wire is cut into small screws it is the work that gives value, not the material; but in a crank pin it is the material that costs more than the work, and the cost of waste of new material on the automatic was greater than the total cost of scrap material, drop-forging, and turning by a boy under the old method.

The American mind is alert; men as individuals have been successful in proportion to their initiative; they have made great individual successes and also great individual failures.

It is not an accident that an American reporter was sent to find Livingston and that an American explorer forced his way to the North Pole. This reckless confidence in impulses, this reliance on individual initiative, is responsible for many failures and even if wild advice is not always followed, it is alarming that it can be so confidently offered.

At the time of the planning of the Grand Trunk Pacific Railway, a brilliant young surveyor and railroad engineer wrote a thesis, urging that the gauge of this new line be made 30 feet, freight cars be made large enough to handle 1,000 tons, and all the buildings in the new villages, towns and cities be erected in standard cement sections. Happily this young man's power was not commensurate with his imagination, but it is not always so. Not only do individuals make tremendous blunders, but corporate bodies make greater ones, because, not being composed of specialists, they are not able to curb the initiative of a strong-willed leader. As a consequence, clearly defined ideals are lacking and this relative lack will have to be pointed out along general lines, using for illustration the seven wonders of the ancient world, the seven wonders of modern times, and in comparison with them seven great American enterprises.

There were seven ancient wonders of the world, each one of them a great work, nobly carried out. Even after the lapse of conturies, moderns of alien races can recognize and sympathize with the ideals that inspired these wonders. One of the tests of a definite ideal is that we can apprehend it even if we cannot always sympathize.

The oldest wonder-work of man is Egyptian —the great pyramid—at once a tomb and an astronomical instrument. The last ancient wonder was also Egyptian, the Pharos lighthouse at Alexandria to direct the floating commerce of the old world to this great city. One of the modern wonder-works is also Egyptian, the Suez Canal, so that through four millenniums Egypt has done a full share.

We can sympathize with the desire to have the largest and highest tomb ever constructed so that the bodies of king and of queen, preserved against decay, may lie in royal state until the time of resurrection. We can sympathize with the conception of the great lighthouse, built by King Ptolemy Philadelphos— even with the trick of the architect Sostratos, who engraved his own name in the solid stone, but hid it by a layer of perishable cement in which he engraved the king's name.

Of the remaining five ancient wonders one was the hanging gardens of Babylon—a peculiarly appropriate glorification of irrigated tropical vegetation which has always been able to support the densest population, a power that may in time turn the tide of civilization backward from Canada, Northern Europe and Northern Asia, back from Argentine to tropical America, to tropical islands. The other four wonders were Greek, one of them the temple of Diana at Ephesus, one the tomb of King Mausolus erected by his widow, one the Colossus of Rhodes, spanning with outstretched legs the entrance to the harbor, and the seventh the master work of Phidias, the gold-ivory statue of Jupiter at Olympia. There was faith or hope or love or beauty or civic pride in each of these seven wonders.

Of the seven modern wonder-works of the world, not one is American. One of them, 400 years old, had its inspiration in religion—St. Peters at Rome, the largest church ever built; the second, 100 years old, is the greatest triumphal arch ever erected, commemorating the victories of the great conquerer Napoleon I; the other five are modern engineering works. It is typical of the changed ideal of the ages that only one of the ancient wonders was utilitarian, and only one of the modern wonders is religious, five being very distinctly utilitarian; yet noble ideals gave them all birth.

Of the utilitarian works the Suez Canal easily comes first. It shortens the sea route from northern Europe to the Orient by 5,000 miles, between certain ports more than half. The canal was begun in 1859, estimated to cost $30,000,000 and to be finished in 1864. Its actual cost was $80,000,000 and it was opened in 1869. The ideal was realized, but none of the other eleven efficiency principles was thoroughly applied, most of them not at all; hence both the double time and trebled cost.

The next great engineering work was also French, the Eiffel tower, rising 1,000 feet into the air, at once the highest structure erected by man and the prototype of modern American steel construction, which as a matter of course followed when passenger elevators or lifts were made practical.

The third great wonder is the Firth of Forth bridge; cantilevers, similar to three pairs of great Eiffel towers, each pair joined at its base, each half stretching out horizontally 900 feet without end support. This bridge is massive in design because wind pressure is more dangerous than train load.

The fourth modern wonder is the St. Gotthard tunnel, 12 miles long, under the Alps. There was a Brenner railroad route over the Austrian Alps; a Mt. Cenis tunnel under the French Alps; but Italy, Switzerland and Germany combined to divert the century-old trade between south and north to a shorter new route, the key to the situation being the long tunnel, more than twice as long as any American railroad tunnel. This enterprise almost failed because the workmen, hygienically neglected, died in great numbers, killed by an intestinal parasite similar to the hook-worm. The doctors ascribed the mortality to the work underground. The parasite has recently appeared in the United States, and may prove as serious a scourge as the hook-worm.

The seventh and last of the modern wonders are the twin cousin ships, the "Olympic" and the "Titanic," conceived and designed to restore to Great Britain the blue ribbon of the sea. Of these seven wonders one belongs to Italy, one jointly to Italy and Switzerland, three belong to France, and two to Great Britain. An ideal definitely conceived in advance and tenaciously realized is manifest in each, and in most of them other efficiency principles are applied, in some only in embryonic vestiges, in others in advanced form—notably in the two steamers, which as to cost, time of completion, and performance, realized expectations.

With these fourteen wonders, each with its own field, we may compare seven great American works of which none is religious, none a monument to beauty, while the utilitarian value of five of them is doubtful.

The Panama Canal, easily the costliest engineering work ever undertaken, is being prosecuted with vigor, and, thanks to the discovery of the yellow-fever mosquito and its suppression, a lock canal will be finished at a cost of about $600,000,000. Of twenty great minds selected by lot, no three would agree as to the ideal back of this great work. Mr. Roosevelt is entitled to speak with more authority than any one else, and his reasons for its building are also those of Goethe—that it was a work that some one would be tempted to undertake, some time, and that the United States was manifestly the proper party.

This is vague and uninspiring. The canal, in times of piping peace, when a navy is wanted for minor police duties only, ought indeed to lessen the need for a double fleet, one in each ocean; but those who favor a strong American navy, capable of holding its own against such a combination as Great Britain and Japan, scoff at the canal as a substitute for a strong navy. They know full well that in case of war with strong maritime powers either entrance to the canal could be made exceedingly dangerous by floating mines, by submarines, by aeroplanes; that it might be easy to destroy the canal itself either by damaging the locks, damaging the dam of the Chagres River, or sinking some vessel in the canal. If, for self-protection, it is imperative for the United States to maintain maritime strength both in the Atlantic and Pacific, it is not safe to risk the national honor and supremacy on any such device as a canal trusting that it will work like a watch in war time.

The next in rank of great American engineering works are the new railroad terminals in the city of New York costing about $300,000,000.

There are engineers who consider big passenger terminals a survival of the time when English coaches started from some central hostelry. Central terminals are perhaps a convenience to through passengers, with trunks;

never to local passengers without trunks. Passengers with trunks are very few, even in the fast through trains. It is possible that these great terminals have been built to accommodate the few hundred passengers who have trunks? The 500,000 people who go to and return from Coney Island on single hot summer holidays have not required great terminals; the million and a half of visitors handled on Chicago day at the Columbian Exposition did not require $100,000,000 terminals; the hundreds of thousands of passengers handled daily at 42d Street subway or at Brooklyn Bridge have not required palatial terminals. In fact, these great crowds would neither gather nor could they be handled if they had to assemble at an initial terminal, and debouch from an arriving terminal, both far from their homes. Passengers want to be picked up at their doors, landed at their doors, like letters; they do not want the plan, now obsolete even in villages, of delivering themselves like letters at the central post-office and collecting themselves like letters from the general delivery or *poste restante.*

Nothing is more convenient than the present plan of checking trunks from house to house in cities far apart, for a charge of one dollar, nothing more convenient than to drop from business office in New York into subway ten minutes before train departure and go to Seattle, Portland, San Francisco or Los Angeles, winter or summer, needing neither hat, top coat, nor umbrella since the traveler is never without cover, and if transfer has to be made it is more comfortable and easier to make it from a Denver train to the Santa Fé flyer at La Junta, Colorado, with its station, than to make a similar change in a great New York, Chicago, Philadelphia, or Washington terminal. The great problem of city traffic is to secure distribution, to scatter foci, to dissolve congestion. Terminals of necessity create and increase congestion. Physically or financially, the ideals justifying these great terminal expenditures are not startlingly apparent. Material and maintenance charges on these great works, if distributed to each incoming and outgoing trunk, or even to each going and coming through passenger, would give a striking modern illustration of Horace's dictum that no artist makes a mountain travail to bring forth a mouse.

The Manhattan transfer station of the Pennsylvania Railroad, the 125th Street station of the New York Central Railroad, are as convenient as the big terminals are inconvenient. One wonders why one or both of these great companies did not acquire financing and directing control of the New York subways, run on them from every part of the city specially colored trains, gathering passengers at every express station, landing them directly at the transfer stations, where without long walk or loss of time, through and even local steam trains could be boarded to every part of the United States.

An arrangement of this kind would have added vastly to the convenience of the passengers, and would have saved a railroad investment of $300,000,000, since the subways are already paying institutions.

The third great American enterprise is the New York barge canal. Railroad men, keenly alert as to its folly, assert that the money to be spent in the barge canal would build, equip, and operate without freight charges a railroad between Buffalo and the Hudson, capable of handling ten times as much freight in the course of a year. A barge canal built by the State seems a roundabout way of curbing and limiting dreaded hypothetical railroad extortions, since the St. Lawrence River and Montreal route more or less fixes export rates from all American ports during the open season of navigation for canal and river.

The fourth great American projected undertaking is the improvement of internal waterways. It is assumed that the railroads are uncontrollable, although a single growl by the Interstate Commerce Commission causes a senseless decline of values in Wall Street. It is assumed by some that internal water transportation, subject to all the vague uncertainties of low water, flood, and frost, can be made so cheap as to bankrupt the railroads, although the Mississippi from St. Louis to the sea, open the year round, is paralleled by dividend-paying railroads. Railroad operation with its chronometer trains 99.97 per cent reliable between terminals 1,000 miles apart has in this respect realized an exalted and noble ideal not to be undermined and curtailed by the return to obsolescent canals and river highways.

Our fifth great proposed expenditure is for an American Navy. If there had been no "Maine" there would have been no Spanish war, no war expenditure of one thousand million dollars, no Philippine problem making us an Eastern

Asiatic power when we have not yet solved a dozen simple elementary problems at home, such as living wages for sweat-shop workers lack of employment, civic honesty and cleanliness.

Every battleship five years old is obsolescent Today's and next year's development of flying machines may make every naval vessel as doomed as was chain and mail armor after the invention of gunpowder, as was the sailing corvette after the development of the steamship. Great Britain needs a navy and has kept up to date, has moreover coaling, repair and cable stations, indispensable to its effectiveness; but the value of great war navies to other nations —Germany, France, Russia, Italy, Argentina and the United States—has not yet been demonstrated; and to two of them, it has proved an added calamity in a losing war.

Nevertheless, being committed to a navy until such time as possible enemies are willing also to disarm, it is with great pride that the American can point to the efficiency of the modern American battleship, more efficient in action and operation than anything on a similar scale thus far evolved by man. Through the improvement of the dependent sequence of distance, accuracy, rapidity, and weight of salvo, the modern American battleship is three-thousand times as efficient as its forerunner thirteen years ago at the battle of Santiago.

Every one of these five great works commits one of our American besetting industrial sins—over-equipment—due to our mistrust of spiritual forces, reliance on material measures. It is almost assumed that if a mistake is gigantic enough it will become praiseworthy.

The sixth and seventh great American works are utilitarian, the subways in New York, and the elevator-served tall buildings everywhere. Even as to these, definite ideals have not been established and followed. Some of the tall buildings sacrifice utility to ornamentation, others are painfully ugly but admirably adapted, while a third class are both ornamental and convenient. As to the subways, in view of the fact that they are an independent system connecting with no other road, it is a pity that they were not made with 6-foot gauge and 12-foot wide double-deck coaches, that they were not built as double-deckers, thus giving 300 per cent greater seating capacity for the same length of platform and for a relatively small increase of initial expense.

It is not either the right or the privilege of the Efficiency Engineer to set up ideals of morality, goodness, or beauty, or to assume that his ideal of purpose is superior; but he has a right to expect that some definite and tangible ideal will be set up so that at the start its possible incompatibility with one or more of the efficiency principles may be pointed out. The ideals underlying British railroad construction are very clear: no grades, no curves, no grade crossings, double tracks, great passenger terminals, and capitalization of all betterments. Although five of these ideals are not compatible with common sense and were not adopted at the start by either practical colonials or Americans, the Efficiency Engineer can accept an estimate of $375,000 a mile, the cost of British railroads, and aid in giving the best result possible for the money, since these ideals are not incompatible with any efficiency principle except common sense.

There is one great American railroad genius, always an idealist, who has risen to the commanding position in the railroad world because he had definite ideals. He states that a railroad company is to be managed to earn dividends, that expenses are by the train mile and receipts are by the ton mile. In twenty years, on these three precepts, he has built up a dominant railroad system. He has developed the country through which his road ran, and lowered rates, because this gave him more ton miles. He has reduced grades and curvatures and used heavy locomotives and long trains because this reduced the cost per train mile. He has reached out for Oriental traffic because this not only gave more ton miles, but equalized traffic, thus lessening ton-mile cost. To each one of the three ideals—dividends, low mile cost, large volume of traffic—each of the other eleven principles could be applied and in unusual measures have been applied by James J. Hill.

Another great railroad executive, J. W. Kendrick, regarded disagreements with labor as consuming time and energy, destructive to peace, loyalty, and harmony, and he therefore resolved to set up a high standard of discipline based on the Fair Deal made attractive by an Efficiency Reward. Not a breath of labor trouble has occurred in six years in the departments to which these principles were applied, and the cost of each item of work has decreased, the standard of excellence has risen, the men have earned more money.

It is, however, in industrial companies smaller than the great railroads that in a few cases high ideals have been adopted.

The ideals of one company are that its customers shall be treated with absolute fairness, that its employees shall be of higher skill and be better paid than those of neighboring competitors, that they shall have permanence of employment. These ideals are an admirable foundation on which a very efficient organization has been built up, and while the managers have not consciously formulated and followed the eleven other efficiency principles, they are applying most of them.

The ideal of another company, to which they make their own profits subsidiary, is that their employees shall be able to lead wholesome New England village lives, the workers working near their homes, the fathers with leisure to retain leadership in their own families. An ideal of this kind is also an admirable foundation on which to build a highly efficient organization for, in corporations as in individuals, what is the profit of gaining the whole world if the soul is lost?

The president of an old and large plant near New York City stated with high-minded dignity the ideals under which he and his partners managed their business, not realizing how few managers had had time or opportunity to formulate such ideals, much less carry them into practice.

"We are not money-mad. We strive to be worthy sons of the worthy fathers who started this manufacturing business two generations ago. We wish to see our employees prosperous, well-paid, not overworked; we wish to surpass the world in the excellence of our product."

These are lofty, kindly, homely ideals and the Efficiency Engineer can frame this picture with all the other principles.

As to definite ideals, we could with profit learn from by-gone ages, although substituting other inspirations. Over one of the Greek Temples the words were carved, "Know Thyself," for which we could substitute, "Know the Spirit Rather than the Externals of Your Business."

In the monasteries of a great religious order, everywhere was the inscription, "Remember that Death Comes." For this we can substitute, "Remember that We Must Endure." One great manager impressed on his workmen that there were just two ways of permanently raising men's wages. To obtain more from the purchaser, or to lessen unit cost of product by eliminating wastes.

The vagueness, the uncertainty, the aimlessness that characterizes employees is but an infiltration of the vagueness, uncertainty, aimlessness, that characterizes employers. There can be no legitimate conflict between rails and locomotive, between locomotive and its engineer and its firemen, no legitimate conflict between engineer and despatcher, no conflict between despatcher and time-table, although the time-table defines to a second the running time of a train going at extremest speed for a thousand miles or more.

If every manager would formulate his own ideals, promulgate them throughout his plant, post them everywhere, inoculate every official and every employee with them, industrial organizations could attain the same high degree of individual and aggregate excellence as a base-ball league. These ideals ought both specifically and by implication to include much that rational labor unions strive for; they ought as definitely to exclude ideals incompatible with efficiency even if labor unions mistakenly advocate them.

For the manager endowed with common sense but two courses are open. To set up his own ideals and reject all efficiency principles that do not accord with them, or to accept the organization and principles of efficiency and to create correspondingly high ideals.

IV

THE SECOND PRINCIPLE: COMMON SENSE

The same care and toil that raise a dish of peas at Christmas would give bread to a whole family during six months.

CHAPTER IV

THE SECOND PRINCIPLE: COMMON SENSE.

DARWIN points out that the maternal instinct makes a mother exaggerate the importance of her offspring, thus adding to its chances of survival. Each of us is quite sure he possesses all the common sense needed, and this is also an important instinct, since without it we would lack self-confidence, initiative, we would be deficient in the ability to do, to accomplish. Before the human being runs, he walks, before he walks he creeps, before he creeps he kicks, and the sprawls of the infant give us promise of the man. Let us therefore concede to each mother that her baby is the most valuable ever born, let us praise the excessive and ill-directed activity of the growing boy. Let us also believe that no one is deficient either in quantity or quality of a form of common sense essential in past decades, but now doubly dangerous, since it not only stimulates activities that are becoming in the highest degree deleterious, but it prevents us from preparing for the dawning era in which brains and hand-skill will take up the work begun with boldness and lusty kicks in our exuberant youth.

It is because I have an abiding faith in the destiny both of my country and its inhabitants that I urge the application to its affairs of efficiency principles. That its people have in the past abundantly made use of a high order of *near* common sense justifies the belief that in the future it will surpass other nations in the use of *supernal* common sense. Let us therefore grasp the difference between the two, and, having grasped it, let us wake up to some of the obvious present stumbling blocks in our national, corporate and individual paths.

The surf rider in Honolulu, who, standing on a board comes in on a curling breaker, is daring, skilled, and intensely alive to the swirls at his feet. He is a good navigator of his kind; but there are men who guide great ships by noting the revolutions of the log, by marking the tick of the chronometer, correcting both by the movement of the planets and the stars. It is by these men, not by the surf riders, that the great business of the world is carried on, but the youthful surf riders of today are to become the guiding captains of the next decade. The common sense of the American is the alert common sense of the surf rider. It is not yet, either nationally, corporately, or individually the common sense of the far-knowing captain on the bridge, and what we need is not more common sense or more alertness, but a diametrical change in our point of veiw. The boy must forget his surf skill for a while and go to the mountain top and learn to know the stars so that he will hold them as friends whatever sea or desert he navigates or traverses.

A single red copper cent seemed of more worth to the small and terrified soul* of a New England statesman than all our splendid country west of the Rocky Mountains, and because he had near common sense, he was will-

* "What do we want of the vast worthless area, this region of savages and wild beasts, of deserts of shifting sands and whirlwinds of dust, cactus and prairie dogs? To what use could we ever hope to put these deserts, or these endless mountain ranges, impenetrable and covered to their bases with eternal snow? What can we ever hope to do with the western coast of three thousand miles, rock-bound, cheerless and uninviting, with not a harbor in it? What use have we for such a country? Mr. President, I will never vote one cent from the public treasury to place the Pacific Coast one inch nearer Boston than it is today." (Part of Daniel Webster's speech in Congress in 1844 against an appropriation of $50,000 to establish mail communication with the Pacific Coast.)

ing to sacrifice anything to New England fishing interests; because he was destitute of supernal common sense, he lost to us the empire lying west of the Rockies north of 49 degrees up to 54 degrees 40 minutes, and, no thanks to him, we did not also lose Oregon and Washington.

Happily there were others, earlier and later, Spanish captains, French gentlemen and French priests, American pathfinders, who in duty, necessity and joy used ice floes as ships, rode the river currents as steeds, wielded the forest fire as an axe, dynamite and mountain torrent as a shovel, until we have got into the habit of trusting to gifts, not trusting to ourselves, of deputizing the fight from our own hands and muscles to vast steam and machine equipment. And while we appropriate these titanic helps, gifts, and implements, we childishly squander our national resources in exchange for perishable luxuries supplied us by older and wiser men, corporations, and nations, who, not having gifts and prodigal equipment, still use their brains and hands—men who trade us sunshine, water, and air for our mined wealth, for our soil's fertility.

At the present market price of nitrogen, phosphorus, and potash, every pound of cotton that leaves our shores carries with it about \$0.03 of soil value, every bushel of corn or wheat carries away about \$0.20 of soil fertility. The nominal profit, about \$0.03 a pound on cotton, about \$0.20 a bushel on grain, is no greater than the market price of what is taken from soil value, and our agriculturist is devoting his great activity, his strenuous life of long hours, to the spending of his capital. The net income is nil.

In the industrial and financial world our four greatest living Americans, all men of extraordinary genius and ability, are: Andrew Carnegie who built up his gigantic fortune by converting into iron and steel, and marketing them, the national resources in iron ore and coal; James J. Hill, who has capitalized his ablity to stimulate the exhaustion of the northwest wheat fields and the Pacific Coast forests; J. Pierpont Morgan, who has marvelously stimulated and financed most of the great corporations existing for the destruction of inherited resources; John D. Rockefeller, who has carried good and cheap light into the hovels of China, of Africa, but who has poured out of America by barrel, by case, and by tank steamer, our lakes of petroleum that it took millions of years of sunlight and earth's internal heat and chemistry to accumulate.

We are nearly all of us engaged in similar work, and as has been said of babies, if our ability to exhaust and destroy were commensurate with our proclivities, the United States would before now have become an emptied shell.

The civilized European and Asiatic national policies are wholly different. They regard us much as the thrifty purveyors of amusement and debauchery regard the recent notorious paranoiac who squandered his inherited patrimony abroad, doing nothing of value with either hand or brain, sweeping all the glassware from a bar in a spirit of wanton destruction, oozing gold to those wiser and more cunning, more active in brain and body than himself, until broken in fortune, mind, and body, he ends his days in an asylum for the criminally insane. What a contrast between this man and the great European artists, Sarah Bernhardt, Paderewski, Caruso, and Génée, who, inheriting no fortune and with no equipment, depleting no national resources, using only brain and muscle, exchange their fleeting efforts for half a million American dollars apiece, which they take back to their native countries, whence it flows again to us in exchange for our irreplaceable products.

Does the American paranoiac differ much from the American State of Nevada which a generation ago, in its golden youth, took $300,000,000 in gold and silver from the ground, exported it all for transitory equivalents, and then lapsed into a sparsely settled desert waste?

Switzerland was to Europe what the western deserts were to North America, a region destitute of national resources, but for centuries the canny Swiss marketed the fighting skill of their sons, who hired out in companies as guards for kings like Louis the XVI of France, or as gateway guards for private palaces, until in French the word "*suisse*" has become to mean "front-door custodian."

When the French revolution curtailed the opportunities for defending kings and palaces, the Swiss started in to market their wild scenery, to this end building good roads and good hotels, making visitors from all over the world come to their country. Up to this time the taste of the educated had been for flat, formal, conventional and tidy landscapes, mountains being held in horror. The Swiss also began to market little blocks of lumber for their weight in silver (after they had carved them by hand and brain skill). They imported raw materials from $20 a ton up, and they exported them again as watches worth from $32,000 to $16,000,000 a ton, the difference between import value and export value being Swiss brains and handicraft. A very high order of supernal common sense animates the Swiss.

No wonder that the former Senators from Nevada, Stewart and Jones, with their lives intertwined into a stupendous example of collective prodigality, experiencing in their own fortunes and activities its effects, studied more deeply the inter-relation of man, national resources and money than all the professors and statesmen of the eastern seaboard; Nevada can teach us more than one lesson. It was in Nevada that two pugilists, one black, the other white, by one hour's strenuous brain and body work before a moving-picture camera, produced pictures with a net export value of $100,000. We can achieve in America when we wake up, and if two of our citizens, Johnson and Jeffries, can manufacture in one hour's time export value worth $100,000, yet not deplete our natural resources, could not some of our citizens of higher moral, mental, and financial equipment use a higher order of common sense and develop for export other products of American hands and brains? The depletion of Nevada was a very high order of near common sense. The production of exportable films of a prize fight is a very low order of supernal common sense.

There is another Johnson, Eldridge Reeves Johnson, one of the few exceptions in our millions, who, by means of a few cents worth of materials supplemented by American brain and hand skill is capturing the great singing voices, the instrumental bands, the speech of great actors, and exporting disks at $5 each to the aggregate amount of millions. All honor to this exceptional man.

The table on page 101, from figures in the June, 1910, report of the United States Bureau of Statistics, shows that one-half our imports consist either of articles of luxury, as silks, wines, diamonds, or of products that do not deplete natural resources, as rubber, sugar, chemicals, or manufactures of which the value is mainly due to highly skilled labor and delicate machinery, as cotton and linen lace, works of art and skill; and that our exports consist largely of prime raw materials, which deplete our natural resources, which are produced in vast quantities by unskilled labor aided by big and rough machines.

Even as to an item like tobacco, in which imports and exports are not far apart in value, imports were 46,838,330 pounds and exports 357,196,074 pounds, more than seven times as much in quantity.

The exported materials, oils, metals, coals, can never be replaced; the exported lumber cannot be regrown in centuries. The imported silk, sugar, coffee, wool, tobacco and wines consist of brain skill, hand skill, sunlight, air and water; the chemicals are often high priced by-products which we waste; china, glass and laces are immensely valuable compared to the materials which make them, are therefore brain and hand products. Of the ten leading imported products, diamonds alone are lasting; all the others are fleeting luxuries, eaten up, drunk up, smoked up, worn out before the year rolls around.

Germany's governmental policy is to encourage the exports of brain, labor, sunshine, air and water; there is nothing in sugar, in alcohol, but carbon, gathered from the air, but hydrogen and oxygen gathered from the rain water, transformed by the sun into beet plants, grown in fields, tilled and weeded by hand, the beet pulp being transformed by other hands and

IMPORTS.

Total imports	$1,557,819,988
India rubber, unmanufactured	$106,861,496
Sugar	106,349,005
Silk	100,003,636
Coffee, tea, cocoa	94,242,360
Chemicals drugs, dyes	90,964,241
Manufactured cotton	66,473,143
Manufactured fibers, linen, hemp, etc	57,624,245
Diamonds and stones	47,799,801
Tobacco, unmanufactured	27,751,279
Spirits and wines	23,384,133
Works of art	21,088,720
Earthenware, china and glass	17,574,890
Bonnets and hats	7,950,530
Toys	6,585,781
49.7 per cent. of total imports	$774,653,260

EXPORTS.

Total exports	$1,710,083,998
Raw cotton	$450,447,243
Animals, meats, leather, furs, etc., not including fish	199,996,328
Breadstuffs	133,191,330
Mineral oils and paraffin	106,976,571
Copper	88,004,397
Rosin, etc., vegetable oils and oil cake	54,412,275
Logs and lumber	51,852,136
Coal and coke	43,589,918
Tobacco, unmanufactured	38,115,386
Fertilizers	8,700,640
68.7 per cent. of total exports	$1,175,286,224

skilled knowledge into sugar and alcohol. Denmark and Holland export butter which takes nothing from the soil. The French import Asiatic silk, weave it at Lyons, and export the finished product. They export wine, by analysis 87 per cent water, 10 per cent alcohol and 0.04 per cent aroma and bouquet. Water and alcohol take nothing from the soil, but the aroma makes the wine worth from ten dollars a pound down. In the peace negotiations between Bismarck and the French in 1871 it was not the money indemnity, it was not the loss of territory, that prolonged negotiations. Bismarck bethought himself to demand 5,000 empty old champagne barrels, impregnated with the aroma, the bouquet-producing ferment, and this the French refused. They had consented to pay $1,000,000,000, they broken-heartedly gave up Alsace and Lorraine, but the bouquet of their priceless wines Bismarck should not have, and in the end they compromised on five barrels. The French were instinctively governed by supernal common sense.

America had great natural resources. The man who grabbed them first and fastest reaped the greatest reward. Tonnage, quantity, became a mania, men and equipment to produce tonnage have been the supreme aim. The American who killed the most buffalo for their hides, felled the largest tree cutting to lumber only the main stem, pastured the most cattle on free government range, scooped or trapped the most salmon by current-turned wheels or other traps, has been a *quasi*-national hero. Because these deeds were done by rifle, by steam saws, by cowboy outfits, by trap devices, it has become instinctive with us to exalt "tonnage" or quantity, to exalt equipment and to underrate organization. The instinct is therefore almost invariably to over-equip and to under-organize, to work with masses and aggregate rather than with details and ideals. Give the American a ton of dynamite and a mountain of rock and he is happy.

It takes neither much intelligence nor much labor to run a tunnel into the mountain, to excavate a chamber, to fill it with explosives, to turn on an electric sparker and blow the everlasting hills into the air, afterwards washing away the debris with a hydraulic jet. It was wonderful to make hydraulic mining pay for gold contents worth less than $0.05 per cubic yard, about one ten-millionth part of the material, but there was another aspect. The hill sides were denuded, the lower rivers clogged, so that the issue between the farmers and hydraulic miners of California was a burning question for many years. Yet as we have seen, the farmer is worse than the miner. We can live without gold, but we shall starve on an exhausted soil.

Everywhere and always there is tonnage mania, and with it over-equipment of plant, too many men and prodigality of material. More capital is invested than is necessary. It is the materal asset that appeals, not the greater value of organization and skill. Even a further step is taken and tonnage possibilities are converted into stock. I knew one captain of finance who capitalized the uncaught fish in the sea and persuaded Wall Street to underwrite the securities.

In field, in forest, in railroad operation and in manufacturing shops there is the same spirit of tonnage mania, lavish equipment, under-organization. It is good that the farmer transferred the bulk of his manual work to animals and more recently to machines. It is not good that his farm machinery, which ought to last with care for 40 years, is used only 30 days each year, is worn out and discarded in 5 years, after a total average use of only 150 days. One-third of the cost of harvesting and threshing wheat is the depreciation of the farm machinery.

From our forests we produced, in 1850, 5,000 million board feet, in 1909, 50,000 million board feet, a total of over 1,000 billion board feet, and a like amount has been wantonly or carelessly destroyed.

Railroad officials of the highest rank and largest experience have testified to the loss of ties by decay, to the waste of fuel, to the enormous losses from inefficient purchase and use of material, to the lack of interest of employees, to the detentions of freight cars, thus indicating inefficiencies of material, inefficencies of labor, and inefficiencies of equipment, but thus far they have not ascertained with exactitude the extent of these inefficiencies nor their cause.

Because for several generations our big activities have been built up on tonnage ideals, it will be exceedingly difficult and disquieting to their officials to change the destructive tendencies, and our whole industrial organization will have to undergo sooner or later the experience of a certain large shop. The company owning it also owned large ore mines, lake steamers, railroads, coal mines, river barges. The main business was originally to make iron and steel. To this end blast furnaces, converters, were built, and to keep them busy the contributory properties were secured. Each and every part from mine to mill finds itself operating on a tonnage basis. The easiest way to reduce costs is to increase tonnage, to put into operation larger and larger equipment. Purchasers wanting thin sheets and small rods have complained to me of the great difficulty of having their orders filled. There is no tonnage in such orders; they do not help the mine, the steamers, the railroads, the coke ovens, the furnaces, the rolling mills. To absorb the tonnage, manufacturing shops are started to convert shapes and rods into finished product, bridges or bolts, etc. One of these shops was selected for the application of efficiency principles. On time-study investigation the automatic machines were found to be delivering but 30 per cent of rated capacity, although the shop was on full time. By discovery of and elimination of the causes of stoppage, the output was increased to 67 per cent and it was then ascertained that working at 80 per cent of rated capacity the shop could turn out more product than required normally by the whole United States. The shop is now working less than half time and is producing more than it ever did before on full time.

As was formerly the case in this shop, "*the immediate*" has been mercilessly held up to every one connected with American work. A generation ago, all but a few of the railroad companies capitalized maintenance and declared dividends out of imaginary earnings. The immediate obscured the future. There has been an improvement at the top, but the minor officials still exercise all their best near common sense in realizing near ideals.

A number of years ago there was a great freight blockade extending west from Buffalo. Every western superintendent was instructed to forward no more cars. A local superintendent at Buffalo had gathered from far and near all locomotives, unreliable cripples as well as good power. The blockade became worse, as the cripples hindered the good locomotives even as women and children would hinder a regiment of marching soldiers. A high official was imported who made quick work of the trouble by sending the cripples away from the field of battle. When it became apparent that the blockade was soon to be broken, word was sent west that on a certain date cars could be forwarded. A smart superintendent of a western division industriously collected all his locomotives, arranged long trains of freight cars in his yards and on his sidings, and when the hour came he forwarded an avalanche of trains and and cars, clearing his own divisions, but hopelessly clogging the next one. As part of his plan he disappeared from his office so that he could not be reached by higher authority and his nefarious myopic zeal be thwarted. He made a tonnage record, he trusted to his equipment, he showed near common sense.

A railroad superintendent had occasion to send one of his locomotives to the central shops several hundred miles away for repairs. The locomotive was quite capable of hauling a two-thirds load, but this was not permitted and the locomotive was not even permitted to go under its own steam. It was put in a freight train and bumped over the road to its own detriment and that of the train and track. The superintendent was adding to his tonnage record. This tonnage mania is one of the curses of American practice. It had its value a generation ago when first erected consciously into an operating principle for blast-furnace output and freight movement by the great minds of Andrew Carnegie and James J. Hill, but it has wrought havoc when applied by lesser geniuses who forthwith, instead of thinking and planning and organizing, clamor for more equipment. The epidemic of broken rails which discredited the Bessemer process and against which railroad executives combined in protest was brought about by the tonnage mania, by the use of piped ingots and few passes. The physical and psychical sledge-hammer blows of Mr. J. W. Kendrick demonstrated the rottenness of the rails.

On one of the great transcontinental lines a gravity grade was eliminated at a cost of $5,000,000, entailing a fixed charge forever of $1,000 a day. The operating cost of the helper locomotives able to handle all the traffic up the grade did not exceed $100 a day.

In the foundry of one of the large Pittsburg machine shops, the castings for a large engine are made. Eighty per cent of the weight and forty per cent of the work occurs in three or four pieces, the flywheel, the bed, the cylinder. On the next fifteen per cent of weight there is another forty per cent of work, and in the final five per cent of weight there is twenty per cent of the work. The founder, aiming at tonnage, molds the big pieces and then clamors for more work, urging the starting of another engine. When the engine parts reach the erecting floor it proves almost impossible to secure the five per cent of missing small castings, involving per ton eight times as much work as the larger pieces.

A structural shop orders the supplies from a rolling mill. The big beams are promptly shipped, because they add to tonnage. The angles and smaller pieces do not come for weeks or months. The superintendent of the structural shop pleads for permission to begin work immediately on material not deliverable for three months. He also has a greedy eye on tonnage. If permitted to do the work ahead of time he clamors for permission to ship it. He is always ahead on big work, always behind on small work.

In a machine shop it is ascertained that a big machine, a flange furnace, a bull riveter, a wheel lathe, can do certain classes of work in shorter time. Very seldom is a careful study made of the yearly cost of operating and maintaining the desired machine, or of the quantity of work that can be diverted to it, or the disposition that is to be made of the displaced machines. The efficiency of the existing machines and men is never ascertained, because there are only a dozen shops in the United States in which any scientific standards of men and machine efficiency exist. The old machines may be working at 60 per cent efficiency, with a standardized cost of $0.90 an hour for machine and man. New equipment costing $10,000 is ordered, with a yearly machine rate alone of $5,000. If the machine is used 2,500 hours, the hourly rate will be $2.00 an hour. The probability is that it can be used only 1,250 hours in the year. This makes the actual hourly charge $4.00 an hour for work which had been taking twice as long at 60 per cent efficiency and at a cost of $0.90 an hour. At 100 per cent efficiency it would have taken only 20 per cent longer time than on the new machine, the relative costs varying from $1.08 on the old machines to $4.00 on the new.

In a plant a new $8,000 machine was ordered by the office because it was believed that certain work was not being deliverd fast enough. It was found that the old machine was working less than three hours a day. Had the new machine been bought it would have increased permanently the operating costs of the company about $4,000 a year.

In over-equipped plants (most plants are over-equipped) if there is an expensive machine capable of working only a few weeks each year, the work ought not to be charged with the tremendous hourly rate required to carry the machine. A legitimate hourly rate is based on the assumption that the machine works full time and the idle hours should be charged to overhead expense. The aggregate of these wasteful overhead expenses is very great. It is common sense, the highest kind of progressiveness, to install a machine that can cut down the time of work to one-half, and this kind of common sense is peculiarly American, but usually the increased equipment is not yet needed, existing equipment is inefficiently used owing to under-organization, and the ill-considered additions are due to the national reluctance either to think or to tire muscles.

The traffic manager of a great railroad apprehends a prospective 10 per cent increase in business several months ahead. He immediately insists on additional equipment, 100 more locomotives and 4,000 more cars, and no one stops to ascertain whether existing equipment is working at more than 60 per cent efficiency. On the basis of past experience the increase is justified, but there are many instances in which equipment takes the place of business, as in the case of the boy who, starting a lemonade stand, does not feel himself equipped for business until he is provided with patent lemon squeezers, ice pulverizers, strainers, patent vibrating shakers, a $50 outfit, from which with great loss of time he produces semi-occasionally lukewarm, watery lemonade in dirty, sticky glasses. He has neither organization, ideals, nor common sense, and so, in his humble way, he tumbles into the mistake of over-equipment, carrying out the national proclivity which prevents us from giving to great industrial problems and questions as much time and analytical thought as a good chess player gives to his game.

The American, from presidents of the United States or of great corporations down to cubs in office or shop, in spite of his natural motherwit, finds himself struggling against quicksands of tradition, whirlpools of immediate necessity, fogs of current practice, of near common sense; and each is in the condition of the great condor, the most skilled of all flying birds, whose nest and starting ledge is in the face of high cliffs, but who, once on the ground, in a fifty-foot circle surrounded by a ten-foot fence is less able to rise than a barnyard chicken.

The elimination of waste through the application of the efficiency principle of common sense is a more difficult task than the elimination of waste from gold-mining operations by the use of better processes. Better extraction from ores, better exploitation of mine tailings, is easily attained by the use of better methods, which do not in any way clash with the training ideals and conceptions of a progressive manager.

Better methods and processes, however important, are a minor part of one single efficiency principle, the standardization of conditions; but to apply all the principles, a manager must be born again, forgetting much that he thought of value, adopting, adapting, becoming adept in new lines of thought. At the start he finds himself enmeshed in an offensive, destructive type of organization which he must use an unfamiliar common sense to modify and remake into a defensive, upbuilding type. Even if he is in a position of highest authority at the top, this is not easy as he must run counter to most of the ideals and life-long practices of an extended line of subordinates. If he finds himself many steps below the top, he is indeed caught between the upper and nether mill stone, for those above him will treat his suggestions with impatience and skepticism, those below him will meet them with rebellion. Even if he succeeds in making his organization constructive, he must then use an unfamiliar common sense to overcome in himself and others a long series of vague, discordant, at best opportunist and near ideals, substituting for these, not utopian and unrealizable, but worldly-wise standards as high as the particular activity will commercially stand.

If a manager has succeeded in modifying the organization, if he has succeeded in emphasizing the governing ideal so that all may understand it and work for it, he suddenly meets new difficulties probably from both customers and government, who will make the occasion of his efforts to eliminate waste, to make better use of materials, of labor, of equipment, an excuse to demand a physical valuation of the material property as a basis on which to regulate freight rates or other charges, thus imposing a direct penalty on efficiency.

It is impossible to lay down rules or to give specific directions as to how we shall convert prejudice and ignorance from without, near common sense within, into supernal common sense.

Near common sense binds to the centre of a sphere. Supernal common sense may, like a star, survey the centre from any part of the vault of heaven, but the Twelve Principles of Efficiency, like the twelve signs of the zodiac, divide the heavens into twelve parts, thus giving us twelve different directions of attack on inefficiency.

To select an upbuilding constructive organization, carefully to determine and adhere to ideals, constantly to survey every problem from a lofty instead of near point of view, to seek special knowledge and advice wherever they can be found, to maintain from top to bottom a noble discipline, to build on the rock of the golden rule, of the fair deal—these are the general problems which supernal common sense must immediately solve. It will perhaps prove more difficult to remedy the evils of over-equipment, the direct result of an elementary organization accustomed to deal with great natural resources.

V

THE THIRD PRINCIPLE: COMPETENT COUNSEL

An army must have its chief, its consulting aids, and its ranks; there must be cog-wheels as well as fly-wheels on every machine—each watch must have its main-spring—each government its supreme head. —HERBERT KAUFMANN.

Persistence is the key to existence. Success invariably rewards the good fight. Knowing what to do or how to do it won't bring results. Action must drive ability. The nail is useless without the hammer. Courage is the complement of knowledge.—HERBERT KAUFMANN.

By co-ordinating the two elementary ideals of management—line, for permanence, authority, discipline; staff for development of high functional efficiency—"scientific management" restores, both to the job and the man, the identity—the individualism—which under ordinary management is lost by a policy of wholesale dealings and mass relations.—CHARLES BUXTON GOING.

For all that seek discipline, hear me, ye great men, and all ye people.—*Ecclesiasticus*, 33.

Oh, Neptune, thou canst save this my little bark, thou canst also engulf it and me. Nevertheless I shall steer it in thy storm with all the skill and strength the gods give me.—*Prayer of Sicilian Greek Sailor.*

CHAPTER V

THE THIRD PRINCIPLE: COMPETENT COUNSEL

WHEN I was a boy, hobnobbing with British boys in various parts of Europe, we relied on the manly art of self-defense, and I was expected to hold my own, by my two fists, backed up by my own courage. We loathed the *savate* dexterity of the French boy, the knife play of the Italian boy, the stone-wrapped-in-handkerchief sling of the German boy, for we considered such methods of defense and offense not according to the rules of the game. Nevertheless, a well-directed kick in the stomach from a French boy stopped very effectually my onward rush, and a slash from a pocket knife in the hands of an hysterical Italian boy, a leather belt loaded with a heavy brass buckle and murderously swung by a German boy, and other similar experiences taught me that bare fists, a stout heart, and supreme contempt both of the personality and ethics of an antagonist, were not sufficient to ensure even an honorable truce, much less victory; so I compromised by carrying a club cane which I had feloniously poached from a king's preserve, the irregularity of acquirement adding a sentimental value to the weapon.

The early American manufacturer, generally of British blood, relied also on his own skill and knowledge. He was a practical man, and if a blacksmith, iron was iron and his own skill mastered the material; if a cabinet maker, wood was wood, not a veneered and inlaid concoction, and his own skill mastered the materials. These early leaders scorned the thought that they needed lawyer, purchasing agent, accountant, bouncer, private detective, doctor, chemist, or standard-practice engineer to help them run their shop and business. They believed in themselves as much as their contemporary in the presidential chair, Andrew Jackson, believed in himself. It has been only by slow and reluctant steps that great American executives, heads of large corporations, have acquiesced in the innovation of specially qualified advisers. The change has come too fast, for there are men—Andrew Carnegie, James J. Hill, John D. Rockefeller—who have not only witnessed the change from the simple to the complex, but who have themselves been the mightiest human element in bringing about the change. Human industrial giants, who know as to the whole scope so much more about a business than any late arrival of a specialist, may well be excused for impatience and scepticism too often fully justified.

A great president of a transcontinental railroad was troubled by the flooding and washing away of his line on the slope of a foot hill. His engineers recommended relocation of the line at a cost of $800,000. The old eagle called for an Irish roadmaster and contractor; out they sped in the president's special, and for a whole day they tramped the situation.

Following their conference and decisions, wing ditches were dug so as to divert the surface water around the hill and away from the road bed, the remedy costing $800 and proving a complete success.

Another railroad president asked his engineering department to estimate the cost of grading a road in Texas. The estimate based on experience elsewhere was $800 a mile. The veteran president, a frontiersman from birth, called in a bright division superintendent and asked him if he could grade the extension for $450 a mile. Committed to the superintendent it actually cost $435. The water chemist to the same president strongly advocated a treating plant at a certain well. The president demurred because it was not at that point that water gave trouble. The chemist insisted that the water showed more grains of incrusting matter than at any other point. The president secured from another official a table showing the number of locomotives taking water at each of the tanks and found, as he expected, that very few watered at the bad tank, very many at the good tank, whose water, containing only half the grains of solid matter, deposited ten times as much in the boilers because twenty times as much was used.

Many of the older executives must today not only fulfil their own duties but in addition see that the inexperienced one-sided specialists do not cause more trouble than they cure. Nevertheless, best practice in any line depends today on such a vast range of experience and knowledge that no one man, even in a very limited field, can master it all. No modern captain has a pilot's license for all harbors, and the wiser the captain, the larger the vessel he commands, the more willing and anxious he is to depend on local knowledge, even if the expert be an Arab, a Malay, a Kanaka, a Maori, or an Eskimo.

The trouble with the water-purifying chemist was that he was too inexperienced, too limited to pass on the whole subject. His opinion was valuable and sufficient as to the grains of solid in each water and at that he ought to have stopped.

Competent counsel cannot come from one man. All around us are the laws of the universe, here and there partly read and codified, but with many great and partially traversed regions. Counsel, direct or indirect, is wanted from each man who knows the most, so that we may not be floundering along on last week's, last month's, last year's, last decade's, or last century's knowledge, but use special knowledge, today the possession of the few, but destined to become world practice.

High-speed steel was made known to the world by Messrs. Taylor and White in 1900. In 1903 one of the great western railroad shops was still without it; in 1910 another railroad shop in the Eastern States was discovered taking 18 hours to turn a pair of locomotive drivers, 3 hours being ample time on the type of lathe used. There are facts about high-speed steel, the dimple of durability, for instance, as yet known only to the few.

In striving for industrial efficiency of operation, we have made pleas for a different type of organization—the defensive, constructive organization instead of the offensive, destructive organization; we have made a plea for definite high ideals instead of indefinite low ideals; we have made a plea for supernal common sense instead of near common sense; but no radical change in either point of view or practice is needed to extend the use of competent counsel from legal, accounting, purchasing, engineering, and other departments to an efficiency department.

The legal counselor of a great corporation is often a vice-president, the purchasing agent is often a vice-president, the chief engineer is often a vice-president, but the efficiency counselor is often a subordinate far down the line attached more by accident than design to some special department.

The legal counselor extends his warning, helping, guiding hand to every other department. "You may not do this because it is illegal; there is reasonable doubt as to another action; there is no doubt as to another plan." He does not pass on finances, records, engineering, or efficiency questions. The financial counselor stands against irregular expenditures however much needed; the purchasing agent buys what is requisitioned in the best and most advantageous market.

In the vanishing era of elementary achievement, efficiency mattered not, but legality did; therefore long ago lawyers were consulted. Efficiency did not matter in the building of the pyramids, but engineering did; and from that time to this the engineer has been supreme in his own department. If it were not for the lawyer passing on charters, titles, agreements, there could be no railroad; if it were not for the financiers raising sums far beyond the power of even the richest individual there could be no railroad; if it were not for the engineer who designs the machinery that produces steel, who designs cars and rails, bridges, turntables, locomotives, there would be no railroad; if it were not for the traffic manager the rails would rust, the cars stand empty; were it not for the operating executives, there would be disasters.

But the railroads and industrial plants almost without exception are operating without efficiency counsel, efficiency problems of momentous import being decided off-hand by intuition. Is it to be concluded that efficiency is of minor importance?

At the present moment the business of the country is disturbed, shippers are arrayed against railroads and railroads against shippers; railroad employees are being urged to act as a voting unit against any one who favors legislative interference with railroad operation. Because it is not competently advised from the efficiency standpoint, the Interstate Commerce Commission prescribes monstrously difficult, even impossible standards, brushing aside the accumulated wisdom and experience of the Master Car Builders' Association. Because they are not competently advised by efficiency counsel, shippers fight any rate increase, unable to point out wherein it is unreasonable, the fact being that many present rates are too low and others too high. Because they are not competently advised as to the economies in operation and maintenance that would flow from efficiency, the railroads overlook the great gain within their grasp while they pursue the much smaller gain from greater rates they may not succeed in securing.

The total annual salary and labor bill of the railroads of the United States in 1908 was $1,035,437,528. There is an impressive appearance of accuracy in these figures from which we are pained to miss the odd cents, but an examination of the sub-divisions shows that the average equivalent obtained is not quite 80 per cent, that a preventable waste occurred of over $200,000,000.

In contemplating this enormous waste, the accuracy of expenditure statement loses its impressiveness, and side by side with these valuable and accurate figures of the expert accountant, we would like to see other figures from the efficiency counselor—other figures of far greater practical import.

The other annual bills for operating expenses were, in 1908, $653,780,115, of which about $500,000,000 was for material. Is the efficiency of material used more than 60 per cent? Wherever it has been carefully and scientifically checked, in railroad operation, efficiency has scarcely reached 40 per cent.

The cost of all railroads and equipment is reported for 1909 at $14,514,822,308. Interest at 6 per cent and average depreciation of 4 per cent (which is low) gives an hourly charge of $165,694 for these two items. An increased use of 4 per cent would amount to a gain of this amount each day, or over $50,000,000 a year. As the net earnings of the railroads in 1909, including sinking funds, were only $1,078,132,-735, the railroads were about $400,000,000 short of earning 6 per cent plus depreciation, but sympathy is not as great as it would be if it were not so evident that annual wastes, a very large part of them preventable, aggregate a sum larger than net earnings.

What the railroads have not yet realized is that natural expenses are progressing geometrically and revenues are only increasing arithmetically. For a time heavier locomotives, larger cars, lessened grades, longer trains, counteracted the geometrical danger, and it is doubtful whether higher efficiency will provide all the remedy needed, whether competent counsel of the highest order will not become imperative. The primary question, however, is not whether inefficiency costs the railroads $100,000,000 or $1,000,000,000 a year; but the question is why either loss should occur, and whether it is not sufficient to warrant competent counsel.

The legal counselor does not, cannot know all the laws and proper legal formalities in every State, and he therefore employs junior and often senior counsel. Similarly a counselor as to efficiency would not pretend to be an expert as to all efficiency, but it would be his duty to be in touch both as to men and scientific reports with all that was latest and best and make it all available for his employer whether individual or corporation.

If the corporation were large it would be the duty of the efficiency counselor to install and develop an efficiency organization, extending from top to bottom even as the accounting department extends from top to bottom. Each minor official would have his own staff of efficiency experts working directly for him, but also even as the timekeeper to a superintendent is subject to the comptroller, so also would each efficiency expert be subject to the direction of the efficiency officer above him.

The chief efficiency counselor would initially advise as to type of organization; he would ascertain what the ideals were and strive for their realization; he would represent supernal common sense; but it is chiefly as to the standardizing of the other operative principles that his organizing ability would be applied. In most operating plants both discipline and fair deal are defective, records are neither reliable, immediate nor adequate, despatching is so elementary as scarcely to be beyond the stage of putting into the shop an order for work, there are few, if any, scientifically made work schedules, there are no standard-practice instructions, no standardized conditions, no standardized operations, and efficiency rewards are defective.

Competent counsel must permeate every efficient organization, and if competent counsel cannot be carried into operation, it is because the organization is defective, because some staff is lacking, and the staff that usually still awaits creation is the efficiency staff.

In coal mining in the United States the question is not whether 5 per cent or 3 per cent of the miners are killed each year, it is not the question whether we kill more or less than England kills, but the question is why a smaller per cent obtains in the more dangerous and difficult Belgian mines.

A cholera epidemic raged lately in Europe. It was particularly bad in Russia, and it made headway in Italy. Several times in the last few years Germany has been infected, but each time competent counsel has prescribed procedure which has stamped out the disease, even as measures advised and enforced by competent counsel have stamped out yellow fever on the Isthmus of Panama.

In chemistry more advance has been made in ten years than in all the previous time; metallurgy, fifteen years ago was in its infancy. A generation ago a hospital was a charnel house and a doctor a peripatetic disseminator of contagion and infection. A generation ago sailing vessels were the rule and ocean steamers the exception, and farming had advanced only one step beyond the Egyptian or Assyrian methods. As this gigantic betterment has come because there was competent counsel, so competent counsel well deserves to be one of the Twelve Principles of Efficiency, and nowhere else is competent counsel more needed than in the application of the eleven other principles.

VI

THE FOURTH PRINCIPLE: DISCIPLINE

The universe wants new ways of doing things, and the new things become old over night. — HERBERT KAUFMANN.

Thinking and doing aren't the same. Good ideas are only seeds. They must be planted and tilled before they can produce.—HERBERT KAUFMANN.

My son, do thou nothing without counsel, and thou shalt not repent when thou hast done.—*Ecclesiasticus*, 32.

Every purpose is established by counsel.—*Proverbs*, 20, 18.

Without counsel purposes are disappointed; but in the multitude of counsellors they are established.—*Proverbs*, 15, 22.

CHAPTER VI

THE FOURTH PRINCIPLE: DISCIPLINE

Undisciplined—that is the word. It is the word for all the progress of the Victorian time, a scrambling, ill-mannered, undignified, unintelligent development of material resources. Want of discipline! The reek and scandal of the stockyards is really only a gigantic form of that same quality of American life that in a minor aspect makes the sidewalk filthy. Each man is for himself, each enterprise; there is no order, no provision, no common and universal plan.

Men are makers—American men, I think more than most men. One sees the light of a new epoch, the coming of new conceptions, of foresight, of large collective plans and discipline to achieve them.
H. G. WELLS: *The Future of America,* Chapter 4, Section 4.

ALEXANDER DUMAS in that most famous of his novels, makes Monte Cristo the hero of one episode of marvelous improbability.

In Italy Monte Cristo had accepted an invitation to breakfast in Paris three months later and had agreed to appear on the minute. On the date appointed the other guests were assembled, very skeptical as to the coming of the mysterious Count of whom no word had been heard since the invitation. The guests are impatient—the host begs for five minutes leeway—the clock begins to strike—expectation rapidly sinks toward absolute zero when suddenly, immaculately dressed, Monte Cristo appears saying "Punctuality is the politeness of kings, but it cannot always be that of travelers and fifteen hundred miles are not easily covered. Excuse the two or three seconds I am late."

It was beyond even Dumas' imagination to state that Monte Cristo started on his long trip also on time and made each stage of the journey day by day, hour by hour, on time. Under the dependent sequence of personal arbitrariness and unstandardized road and horse conditions, it was indeed marvelous that he should arrive within a week of the time set, much less within a day, an hour, or a minute.

Now hundreds sweep over the nearly thousand-mile stretch between Chicago and New York on Monte Cristo's fraction of a minute precision. They start on the minute, they pass each station on the minute, they arrive on the minute; if there are delays, the passengers grumble mightily and the railroads pay rebates. The institution built up on time schedules has become mightier than the man and the man is immensely benefited by the discipline of the institution.

Thirty years ago along the great inland rivers of the United States, the Ohio, the Mississippi, the Missouri, the greatest difference was apparent between the river towns and the railroad towns. In the river towns steamboat passengers were quite content to wait several days, idling on the levee, whittling or swapping yarns or doing the *dolce far niente* on the hotel piazzas. When far up or down the river the deep bellow of the boat's whistle was heard, day or night, the sleepy town awakened into prodigious and spasmodic activity until the boat had come and gone; then it went to sleep again. Clocks were not needed and all business was conducted on the same easy lines. Notes were paid, not when they were due, but when the crops were marketed. An Eskimo who figures years as so many snows, months as so many moons, and days as so many sleeps, would have found the business methods of the steamboat town wholly normal—steamboat coming down the river, great excitement; whale seen in the offing, great excitement—what was the difference? In the railroad towns there was a very different spirit. People had clocks in their houses and watches in their pockets; they went to the railroad station on railroad schedule time; the coming and going of the daily trains became definite, regulating and educational events even to those who never traveled; they fell into the habit of keeping other appointments; they were beginning to learn that the institution was greater than the individual.

The near discipline of the rich man who makes his servants await his convenience in spite of a definite program arranged by himself, the near discipline of some railroad magnates who more or less disarrange the train despatching on a whole system by their lack of observance of their own special train schedule, the near-discipline that would bend the sublime order of the universe to individual dilatoriness as in the story of Joshua's command to the sun to stand still, is not what is meant by "Discipline" as an efficiency principle.

There is the discipline of life which leads us, almost compels us, to follow the teaching that comes to us from intimate contact with the existing order. "The wicked shall not live half their days." It is easier to learn to fly than to make a landing. In a narrower sense we speak of the discipline of St. Francis, of St. Dominic, of Ignatius Loyola, meaning not punishment but a definite, regulated life, conduct, and observances. In the narrowest sense we use the word to denote the act of punishment inflicted on a bad boy with the object of encouraging observance of prescribed conduct or rules.

The word discipline thus has three—if not more—meanings.

Adam began to experience the discipline of life when Eve became his daily companion; discipline and the greater life began in earnest for both of them when they found themselves outside the gates, with Cain, Abel and Seth frisking around, for there is no such categorical imperative as the sharp outcry of a very young baby. Adam and Eve, owing to lack of experience and overvaluation, spoiled Cain; so being undisciplined, his exaggerated personality could not brook the preference shown Abel and he murdered him.

Discipline as an efficiency principle includes all meanings, from lessons of life to man-inflicted punishment. The greatest regulator of conduct is the spirit of the organization.

I did not like being the only man in a dress suit at an informal business men's dinner in

Boston, nor did I like being the only man in flannel shirt and mucklucks at a Nome ball. The spirit of a place is intangible, but counts far more for either evil or good than all rules and punishments combined. So powerful is this spirit that it has been cynically said most men would have fewer conscience pricks over an undetected crime than over a ridiculed solecism.

Is it not incredibly short sighted to throw to the winds such mighty helps to discipline as the spirit of the plant, the general scheme of conduct, and to place reliance in the undisciplined acts of discipline of individuals clothed with a little brief authority?

Nature is a relentless disciplinarian.

Because the success of the whole plant depends not on its wealth, or its men, or its product, but on its spirit and rule, penalties for persistent infraction should be relentlessly severe. A whole race is exterminated in Africa because through ignorance it braves the bites of the tse-tse fly. If we fall asleep in charcoal fumes we do not awake, if we touch hot iron we are burned, if we put our heads under water for five minutes we drown, if we touch through mistake a live high-voltage wire, the penalty may be instant death. There are no rules and regulations about these punishments, they need no rules and regulations.

The old story runs that Eve and Adam were banished from Paradise for eating a forbidden apple and that all their descendants not only cannot get back except by very special favor, but will have to spend all eternity in hell. Cain's punishment was also exclusion; he became a fugitive and a vagabond, he was not to be rewarded for his work and he bitterly complained that his punishment was greater than he could bear. One, Cook, wrote a cheerful book about scaling Mount Bulshaio and later sent some thrilling messages about the North Pole. Not because Peary accused him, which most people resented, but because his own stories and acts proved him a liar, he had to flee, like Cain, into obscurity and oblivion although no man pursued.

Enforced resignation is one of the severest penalties in the army and navy; on a great railroad in the middle west employees were rarely discharged; they worked themselves up or down by an automatic system of merit and demerit marks. In another great American business, a large specialty store, the making and enforcement of rules is turned over to a committee of the employees. It is a universal experience that no judge is as severe and unrelenting as the more righteous contemporary with the same temptations and opportunities. It is not the child, the man, or the older woman who condemns Magdalen. It is not the child who pities the playmate killed by carelessness, it is not the successful old man who pities the gray-bearded derelict who has made a general shipwreck of life.

If the spirit of the plant does not drive an undesirable associate away, if standard operation and standard practice, both of which affect conduct, if reliable, immediate and adequate records, if absence of efficiency reward do not automatically, effectually and peaceably eliminate the undesirable, it is time for the strong hand to descend. There are certain all-night restaurants in the tenderloin district of New York frequented by roysterers of both sexes after the more reputable places are closed. A good-natured tolerance prevails for even unusual hilarity and noise, but just let any misguided guests try to start something, they suddenly find themselves seized and deposited outside on the car tracks with locked doors between themselves and joy. The disciplinary hand is resistless, immediate and strong.

Under the best management there are scarcely any rules and there are fewer punishments. There are standard-practice instructions so that every one may know what his part in the game is, there is definite responsibility, there are reliable, immediate and adequate records of everything of importance, there are standardized conditions and standardized operations and there are efficiency rewards.

There can be organization without discipline, as in all plant life; there can be discipline without organization, as in most animal life. Because man has supernal ideals; because, if organization is weakened, the progress of centuries can be lost in a year, in a minute, as during an earthquake—the devil indeed catching the hindmost; because our unstable human organizations, even the integrity of the family, depend on discipline, it becomes a fundamental efficiency principle which continuously, vigorously, never falteringly must enforce a series of standards of high individual or combined conduct.

"He that ruleth his spirit is better than he who taketh a city." Discipline is not arbitrary rules with punishment for short-comings, real or imaginary.

The tremendous simplicity of the scheme of the universe is the real marvel of it all. Universal attraction and universal repulsion—all elements have approximately the same atomic heat—but three principles underlie all life—self-preservation, race-perpetuation and the proprietary instinct. From a few elementary laws, other universal laws spring; and any near-law that cannot trace its parentage straight back to one of the supernal laws, if indeed there is ultimately more than one supernal, is probably not even a legitimate near-law.

Fine manifestations of disciplined performance are the four eighteen-hour trains each day between New York and Chicago. So unobtrusive is the perfect discipline that the passenger sees no rules or orders given, he does not see the far-ahead light or semaphore signals that govern progress, he sees still less the telegraphic messages flashed by the despatchers to the signal towers, he knows little of the duplicate orders issued to conductor and engineer. The discipline is that of the velvet paw armed with the sharpest claws, infraction possibly resulting in destruction of the whole train, a trans-human punishment; infraction, even if there is no immediate disaster, resulting in reprimand or dismissal.

Many years ago I became interested in a socialistic experiment on the shores of the Pacific. In that favored region of mild climate, tall timber, waters teeming with fish, woods alive with game, the earth covered with fertile soil, a man and woman would be justified in starting married life with a fish net, an axe and a spade, a cook pot and a jack knife. They might catch enough fish in a single day to last a whole year, and if it was not the season for fish, they could dig clams with the spade, pick wild berries in abundance, and easily split cedar logs, for canoe or hut. The skins of wild rabbits furnish blankets and clothes.

It was in this part of the country that a band of earnest men and women, some militant, some supine, some altruistic, some selfish, but all dreamers, resolved to start a socialistic colony, "to ease the strong of their burden, to help the weak in their needs." Members were either to contribute or to work. Contributing members were to pay $2.50 a month to be spent in the purchase of land, implements, machinery, and all else that the colony could not make for itself. Working members were to clear the ground, erect buildings, build boats, sawmills. Capital exacting no interest, labor never striking, were to combine in making the wilderness a paradise.

The contributing members, in case of disaster overtaking them in the outer world of competition, were to have the right to move at once to the colony where they and their children would find a ready-made home, an asylum from want and poverty, becoming working members as strength and ability permitted. Ranks of workers were to be recruited, partly from contributing members, partly by admission. The plan seemed feasible, especially as a large tract of valuable meadow and forest land was given by one of the enthusiastic founders, a theosophist who lived altruism.

I spent some time at this colony as a visitor. I met noble men and women, but I also met drones who lolled in bed while others worked; drones who expected to be waited on, and as I watched I came to admire the spirit of the beehive which ruthlessly cuts off the wings of useless drones and pushes them outside the hive to perish.

I also noted that capital and labor in combination are not enough, that the essential to direct both is after all the organizer, the disciplinarian; and I perceived that it was the discipline of St. Francis, the discipline of St. Dominic, the discipline of Ignatius Loyola, that made these great monastic and religious orders enduring and successful century after century, even as it was the discipline of the Old Man of the Mountain and his successors in spite of their atrocious practices and beliefs that maintained for two hundred years the power of the sect of the Hashishim or Assassins.

So great is inefficiency of all kinds everywhere that the application of even this one principle of discipline has produced great results through military or church organizations. Just as soon as a community bends to discipline, whether its members are followers of Romulus, of Leonidas, empires are either founded or shattered, and just a little discipline as to dress and work has made such American communities as the Shakers, Economites, Mennonites, wealthy. In the army, as in the church, the first vow is obedience; and in Schiller's ballad the slaying of the dragon did not save St. George from condemnation and punishment for his disobedience. The large office buildings in New York are peculiarly dependent on discipline. They are miniature cities in which all municipal activities, lighting, heating, cleaning, transportation, are constantly going on. As long as the tenants are present from 8 a. m. to 5 p. m. high order is maintained, but shortly after 5 o'clock discipline relaxes, attendants raise their voices, begin to smoke cigarettes, to romp, and the conviction grows that if these modern palaces were turned over as a possession to their own trained attendants, in an incredibly few weeks they would be marred and scarred, dirty and disorderly, physically and morally.

Family life can exist in the Gypsy caravan or in the Arab tent or Indian tepee, in the wolves' den or in the bird's nest, but we owe the continuance of civilization to the citizen efficiency and standard-practice engineers, men and women, heads of great institutions, governments, corporations and enterprises, who design and erect the firm skeleton of discipline that maintains in place the units of individualism, lest the whole aggregation tumble to ruin at the first shock in earth or air.

In marked contrast with the vagueness and looseness of obligation and control in the social colony that failed, is the high organization and discipline of modern baseball teams in which individual effort and reward has been happily combined with team work and collective reward. In baseball each man disciplines himself; to this is added the discipline of the team, and on top comes the discipline of the league. Without high individual standards, without team codes enthusiastically lived up to, without severe penalties to enforce obedience to the umpire and peace between the teams, the modern game would be impossible. It is the spirit of discipline, not its letter, that counts, and the spirit is reciprocal from bottom to top, from top to bottom and sideways to all associates; it is reciprocal between the individual and the flag under which he is industriously enlisted.

I have been asked why "co-operation" was not to be considered as one of the twelve basic principles of efficiency. Common ideals striven for by a disciplined organization, supernal common sense which forgets the little for the sake of the larger achievements, necessarily result in co-operation, even as the bees, having accumulated a full store of honey, seem to obey a queen, who "as it happened with many a chief among men, appearing to give orders, is himself obliged to obey commands, far more mysterious than those he issues to his subordinates." The fundamentals of discipline are in fact better learned from the government of a beehive than from college courses, from armies, or from any industrial organization. No bee appears to obey any other bee, no bee seems consciously to co-operate with any other bee, yet so perfect is the "spirit of the hive" that every bee engrossed in her special task, fatalistically acts on the instinct that all other working bees are also as busy for the common good, and when the drones fail to be useful the working bees become consciously indignant and make away with them. Co-operation is a matter of course, not a virtue; its absence is the crime.

Supernal discipline is inspired by a greater emotion than fear.

Frank T. Bullen, in his story praised by Kipling, "The Cruise of the Cachalot," describes the high type of reciprocal faith that in great emergency resulted in a perfect discipline, and the story in abbreviated quotation illustrates what is meant by discipline inspired by faith.

At Port William, New Zealand, two whale ships lay, the Tamerlane and the Chance. The American Tamerlane was neat, smart, and seaworthy, but the colonial

Chance looked like some poor relic of a by-gone day. Old she was with an indefinite antiquity, carelessly rigged and vilely unkempt, but the old Chance made a better income for her fortunate owners than any of the showy, swift, coasting steamers. Captain Gilroy, familiarly known as "Paddy," the master of the Chance, was unsurpassed as a whale fisher or seaman by any Yankee that ever sailed from Martha's Vineyard. He was a queer little figure of a man—short, tubby, with scanty red hair and a brogue thick as pea soup. Overflowing with kindliness and good temper, his ship was a veritable ark of refuge for any unfortunate who needed help, which accounted for the numerous deserters from Yankee whalers who were to be found among his crew. Whaling skippers hated him with ferocious intensity, and but for his Maori and half-breed body-guard he would have been killed. On that storm-beaten coast he knew every rock and tree in fog or clear, by day or night, he knew them as the seal knows them, and feared them as little. His men adored him, they believed him capable of anything and would as soon have doubted daylight as the wisdom of his decisions. One common interest, their devotion to their commander, united the very mixed crowd, sixteen European and American sailors, twenty-four Maoris and half-breeds. . . . . . The Chance was there and three other whalers, competitors. Without any warning the wind flew around into the northward, putting the four ships at once into a most perilous position, and there to leeward loomed grim and gloomy one of the most terrific rock-bound coasts in the world. The Chance was a good mile and a half nearer the shore. The sea, gathering momentum over an area extending right around the globe, hurls itself upon these rugged shores. As the craft drifted helplessly down upon that frowning barrier, excitement grew intense. It would not be possible for them to escape if they persisted in holding on, but it was easy to see why they did so. Paddy, far to the leeward, was in much more imminent danger and it would be derogatory in the highest degree to the reputation of the other captains were they to slip and run before he did. He, however, showed no sign of doing so, although they all neared that point from whence no seamanship could deliver them and where death, inevitable, cruel, awaited them. A gigantic barrier of black naked rock rose seven or eight hundred feet sheer from the sea. Nothing broke the immeasurable landward rush of the majestic waves towards this world-fragment. Against this perpendicular barrier they hurled themselves with a shock that vibrated far inland and a roar that rose over the continuous thunder of the tempest-driven sea. High as was the summit of the cliff, the spray rose higher so that the whole front of the great rock was veiled in filmy wreaths of foam.

Towards this dreadful spot the four vessels were being resistently driven. Suddenly, panic-stricken, the ship nearest the Chance gave a great sweep round onto the other tack. They had cut adrift from their whale, terrified beyond endurance into the belief that Paddy was going to sacrifice himself and his crew in the attempt to lure them with him to inevitable destruction. The other two did not hesitate longer.

The Chance drew in closely to the seething cauldron of breakers.—Who among sailor men having seen a vessel disappear from their sight under such terrible conditions ever expected to see her again?

It appeared that none of the white men on board, except Paddy, had ever before been placed in so seemingly hopeless and desperate a position, and yet when they saw how calm and free from anxiety their commander was, how cool and business-like the attitude of all their dusky shipmates, their confidence kept its usual high level. The test was of the severest, for to their eyes no possible avenue of escape was open. Along that glaring line of raging, foaming water not the faintest indication of an opening. The great black wall of rock loomed up grim and pitiless. All stood motionless with eyes fixed in horrible fascination upon the indescribable vortex to which they were being irresistibly driven. At last, just as the fringes of the back-beaten billows hissed up to greet them, the ship plunged through the maelstrom of breakers—they were on the other side of that barrier, the anchor was dropped, the vessel rested like a bird in her nest on a deep still tarn, shut in on every side by huge rock barriers. Of the furious storm, but a moment before howling and raging, nothing remained but a thunderous hum, and high overhead the jagged, twisted, tortured cloud, whirling past their tiny oblong of sky.

Such a feat of seamanship was almost beyond belief. The little, dumpy, red-faced figure, rigged like a scarecrow, bore no outward visible sign of a hero, but in our eyes he was transfigured, as one who in all those qualities that go to the making of a man had proved himself of the seed royal, a king of men, all the more kingly because unconscious that his deeds were so exalted.

If this disreputable little Irishman in the midst of filth and inadequacy could maintain, by qualities of soul alone, a discipline so admirable among a crew of flotsam and jetsam under stress so terrible, what ought not to be accomplished by leaders with all the advantages of education, experience, organization, with picked crews of workers? Unless I know that the employer is without fault, unless I know that he is struggling with an inherited, vicious condition, I have no patience with so-called labor troubles, almost always due to neglect of elementary precautions for the common benefit of master and man. There is at least one large business aggregation in the United States in which a strike is unthinkable because it is a coveted privilege to be admitted to it as a worker, a catastrophe to be cast out, and so high is the *morale* that the workers themselves make and maintain standards of conduct far stricter than any usual employer would dare to enforce, although he may print and post rule after rule.

The time to inspect boiler sheets is before they are made up into steam boilers; the time to inspect anchor chains is in the making, not when the great steamer is straining with broken machinery to the windward of the Scilly Islands in a midwinter storm. In all industrial life everything is tested, materials, design, except the all-important men. In the little shop, rigidity of human inspection is high, the master looks over each man, has probably watched him for months or years before engaging him; but in the large shop, where personal inspection by the master has become impossible, even the most elementary safeguards are thrown to the winds and men are absorbed with less discrimination than the furnace under the boiler absorbs air.

No man enters West Point without passing severe elementary examinations. It is a tremendous privilege to be admitted, a disaster to be excluded. There ought to be a high membership ideal for every plant, no newcomer admitted who is not fit in every way, no man cut off except for cause. Discipline begins before the applicant is taken on. Nine-tenths of all the harder discipline ought to be applied to exclude undesirables, men who by reason of bad character, bad and offensive habits, destructive tendencies, laziness or other faults are unfit to become working members of a high-class organization. It is before he is admitted that the applicant should hear of the ideals of the business, of its organization, of its methods.

On the Yukon we divided men into two classes, the competent scoundrels and the incompetent goody-goodies. If it is a duty to exclude the morally unfit, it is also a duty to exclude more vigorously from any particular occupation those who are congenitally unfitted to make a success of it. A blind man may become a self-supporting, useful and successful member of society, a man born without legs may become the successful owner and operator of a livery stable, driving, harnessing and unharnessing horses, but a blind man cannot act as the lookout on an ocean steamer, the deaf man cannot lead an orchestra, and the legless man cannot become a foot racer.

A few hours' investigation would determine whether an applicant for a working position were really qualified, but the few hours are rarely given.

The type for the great newspaper is set up by linotype operators. Apprenticeship is rigorously limited. Some operators can never get beyond the 2,500-em class, others with no more personal effort can set 5,000 ems. Do the employers test out applicants for apprenticeships so as to be sure to secure boys who will develop into the 5,000-em class? They do not. They select applicants for any near reason except the fundamentally important one of innate fitness. It is not a question of wages, though payment is for timework, but it is a question of rapidity, of more news at a later hour, of a better utilization of an expensive machine, of lessened rent for space—in fact, of greater output in less time at less cost.

In railroading, why should each conductor and engineer be compelled to secure a watch of the best grade, why should this watch be periodically inspected, yet the future conductors and engineers be recruited in the most haphazard fashion? There is scarcely any greater or crueler injustice to a boy or to a young man than to allow him to enter on a career for which a competent examining committee would tell him he was unfit, there being other careers for which he is better adapted.

In coal mining, seams of coal with bands of slate, clay, or dirt are not mined, or the coal is carefully picked over, or washed; in lumbering all material is graded, millions of feet of inferior grade being burned; in wheat raising the farmer strives to attain grade; standards are devised and rigidly adhered to in the livestock markets; but a company building cars or running a factory or mining coal will engage and employ almost anyone that applies for work, who is not under age, over age, or absolutely crippled.

The master organizer, whether saint or assassin, does not admit those who would make trouble and he thus avoids nine-tenths of possible insurrection; the master organizer creates a collective spirit that prevents another nine-tenths of disciplinary troubles, a dependent sequence that brings his remnant of insubordination down to one per cent of the usual and possible and with this one per cent of remnant he easily deals.

As I write, the morning papers contain three items. "Manchester, England; The Federation of Master Cotton Spinners has locked out

130,000 men. Berlin, Germany; Negotiations with the object of preventing a lockout of the metal workers have failed. Nearly 100,000 men are affected in Berlin alone, it is estimated that at least 500,000 throughout Germany will be turned out. Paris, France; 80,000 strikers tie up railroads. Entire country may soon be involved."

Whatever the merits of the cases, it is safe to say that most, if not all, the principles of efficiency were flagrantly absent in these three great disputes. In the case of the cotton spinners the story runs that a foreman discharged a worker because he objected that certain assigned work was not in his line. Ought it to be possible for two men in the bottom ranks of a great business to bring on a strife involving 130,000? Were his duties made clear to the worker before he entered the company's employ? Ought the foreman to have had the power to discharge him for an objection, on its face, entirely reasonable and sustained by his fellow-workers? In this dispute we have the old-type, arbitrary, anarchical organization of both masters and men; defective discipline, rejection of competent conciliatory counsel, painful absence of common sense, no high ideals.

Under efficiency principles there would have been staff advisers to invent and build up safeguards against catastrophes of this nature, just as levees are built along the banks of rivers inclined to flood. Trouble-making men, whether workers or foremen, could neither have gone on the payroll nor have stayed on it. There would have been staff conciliators whose business it would be to take in hand incipient emotional flames and smother them before they grew into great conflagrations.

The principles of efficiency are not vague platitudes; they are intensely practical, tested, tried out, and successful. The strong leader who employs them prevents wastes, prevents the losses caused the State and community by the cessation of labor of hundreds of thousands of men, prevents the greater misery and suffering due to the enforced idleness of heads of families. While master and man quarrel and bicker, the State suffers and women and children pay the penalty. Socialism gains recruits not from the arguments of its advocates, since no human being is naturally a socialist, but from the unendurable shortsightedness and shorter temper of individualistic men.

It is not enough for the owners to have

ideals; they must be transmitted to the employee, and nothing is easier, as any one who has studied the psychology of crowds knows; but it is idle to expect the average worker to rise above the spirit of the place he works in. If it is untidy, disorderly, filthy, if the accommodations for his necessities are lacking or vile—saw-tooth lighting, compound condensing engines, imposing steel and concrete construction, and all the over-equipment to which in the past we have pinned our faith, will not inspire the worker.

On one occasion, beginning an investigation of a great machine shop employing one thousand men, I went the first morning at half-past six to the power house. It was a dark day early in February, temperature 8 degrees below zero and the shops were none too comfortable. When the whistle blew at seven o'clock I watched the ammeter line. The power consumption rose instantly to what proved to be the average maximum and it stayed up. I returned at 11:30 and watched the ammeter line stay up until 11:57, at which time the record, reliable, immediate, and adequate, began to round off, suddenly dropping as the noon whistle blew. It came up again at 1 o'clock and stayed up until 6 o'clock. The two parallelograms were very different from the flattened records, shaped like half ellipses, so usual in similar shops. It was evident that the superintendent was a man of discipline, and the opinion I formed in that forenoon of his ability was confirmed by three years' intimate association. It was his practice to enter the shop at 6:30 a. m. to stay until after 6 p. m., and I heard him severely reprimand a foreman for allowing the superintendent's father, a worker in the shop, to take off his overalls five minutes before closing time. Men worked enthusiastically, loyally, and reliably for this master of men.

The way to guard against trouble is to make the position desired by a superior man, to allow it to be filled only by a superior man, to maintain the position at a high level. If the owners and managers of a plant of any kind are orderly, enthusiastic, loyal to the work, punctual, courteous, decent, competent; if they feel their obligations toward those they direct; if they are honest, economical, diligent and sound in health, they can well demand similar qualities in all the employees. I have placed order first, believing in the spirit of the proverb that order is nature's first law and also the remark which Goethe puts into the mouth of Mephistopheles: "Make use of time, it is so fleeting, but order saves time." No man ought to be allowed to enlist who cannot start in with order, enthusiasm, loyalty, reliability, who is not courteous and decent; no man ought to expect to stay who is not competent, a good brainworker, honest, economical and diligent. If in addition he has good health, so much the better.

The self-executing discipline that is worthy to be an efficiency principle is the allegiance to and observance of all the other eleven principles, so that the twelve principles do not bebecome twelve rules unrelated to each other; they do not become separate and easily dislodged rails of a fence, which is more an indication of boundary than a barrier; they do not even become the iron palings of a French fence, whose spacings as a boy I had carefully tested by my head, knowing that where this member could pass my body could slip through—much beloved interstices, an ever-ready path to safety when pursued by outraged minions of the law or exasperated householders or other representatives of the established order against which I was in perennial rebellion. As promoters of observance of arbitrary rules to which as a free American boy I had not given my assent, these elaborate fences were joyful failures.

It is otherwise with the rabbit-proof, dog-proof, hog-proof, bull-proof, wire-netting fence whose meshes cannot be squeezed apart, whose barbs punish familiarity, which is strong enough to kill outright an animal running diagonally against it.

The twelve principles of efficiency are the strands of a net, each interwoven with the other so that in reality the first study of any organization is to find out to what extent common sense, competent counsel, discipline, and the other eight principles have been applied to the first principle, "Ideals"; to find to what extent ideals, competent counsel, and discipline, have been applied to common sense; to find to what extent ideals, common sense, competent counsel, have been applied to discipline. Any system or act of discipline that cannot pass the test of each of the other eleven principles is near-discipline, not supernal discipline—is a remnant of arbitrary individualism, the first misstep in an anarchy that will extend all the way down the line.

No efficiency principle stands alone, each supports and strengthens all the rest, each is supported and strengthened by the other eleven. They are not as mutually interdependent as the stones of an arch, each a keystone which if removed brings about the collapse of all the others; they are more like the stones of a dome, any one of which can be taken out, leaving a weakened, but not destroyed structure.

Chapter VII

THE FIFTH PRINCIPLE: THE FAIR DEAL

We have progressed so rapidly in material prosperity that we have lost our heart and our humanity."—*W. L. Ward.*

Either side gets just what it grabs. Hence if I were a workman I would go back into the union and fight fiercely for a high, straight wage and eight hours and if I were an employer I would battle for straight piece work. To my mind the matter of justice is chimerical bosh. Either side will get just what it has power to take. It is the law, the fight of life. The mechanical industrial army is now to America what the Prætorian Guard was to the Roman Empire—at once the support and menace to the country.

For this reason I helplessly turn to the sole recourse of laughing at the individuals who become flushed in their earnestness over the details of the struggle. Nevertheless I think great work was done on the Santa Fé—no one better than myself knows the obstacles to overcome in order to make your plan work. It seems to have smoothed down in a masterful manner the plumage ruffled by the antecedent strike. While I do not personally believe in the protestation of a desire for fair play, you seem to have convinced notable representatives of both sides of the plausibility of an impossibility."—Extract from letter written July, 1907, by the associate editor of "the oldest journal and the leading journal of its kind, published at the greatest railway center in the world."

We have ventured to place the extract above in immediate juxtaposition to Ward's dictum, because it is a specific definition of the mental attitude of the employing class which is the most serious obstacle in the way to a better, a more efficient, order. It formulates the doctrines to which the Twelve Principles of Efficiency are an earnest gospel of dissent.

Justice without discretion may do much; discretion without justice is of no avail.—CICERO.

Most of man's misfortunes are due to man.—PLINY.

VII

THE FIFTH PRINCIPLE: THE FAIR DEAL

THIRTY years ago there was a deep-worn trail leading from the plains of Texas to the forks of the Platte, a distance of 800 miles. This trail I could recognize by its furrowed hollows if I drove across it in darkest night. Long-horned, wild-eyed, cat-hammed Texas steers, half a million in a season's drive, slowly grazed northward, bringing Texas fever with them. The heifers were retained in Texas to become the dams of other inferior long-horns. All this is changed. Short-horn, Hereford, Galloway bulls have resulted in graded short-horn, well-rounded, well-mannered progeny which travels north in palace stock cars and there is strict quarantine against Texas fever.

The best basis for peace, for harmony, for high performance, is selection of the human thoroughbreds, exclusion of the undesirable human Texas long-horns.

It is in this manner that our future officers, military and naval, are recruited. Having been carefully selected by education tests, by physical measurements, and with some reference to moral antecedents, they are then given the fair deal. There is, therefore, owing to these elementary, obvious but insufficient precautions, a diminution in the army and navy (compared to civil and industrial organizations) of dishonesty, of boorishness, of flagrant going wrong. During good behavior they remain; their promotion is sure although slow, their position is high, they are welcome guests in society and at the most exclusive clubs.

Should not these simple selective practices based on several thousand years of experience be taken to heart by industrial organizers?

The captain of a whaler recruits his motley crew by fraud and violence and rules them with the discipline of the Old Testament: eye for eye, tooth for tooth, hand for hand, foot for foot, burning for burning, wound for wound, stripe for stripe, *lex talionis* in all its hideousness. He who recruits his shop with scarcely more discrimination, who does not even attempt to find out whether the young applicant is suited mentally, physically, and above all in capacity for what is to be a life work, who does not attempt to find out whether the itinerant applicant is morally and industrially a fit associate for the other men, an acquisition or a detriment—a near-organizer of this kind must necessarily rely on foremen as arbitrary and undisciplined as himself, must necessarily rely on physical rather than on moral suasion.

The name of Leonidas has thundered down the ages. When Xerxes invaded Greece with an army of a million men recruited from forty-six nations—almost as many nations as are represented in the great Pittsburg shops—he offered Leonidas the kingship of all Greece, but, spurning this offer, the King of Sparta selected only 8,000 men from the quarreling Greek contingents. When the pass of Thermopylæ was turned through the treachery of a Greek, Leonidas excluded and sent away all his allies except 700 Thespians, and with these and his 300 Spartans remained to do battle as long as one remained alive. The more select the force the greater its efficiency.

When we see ill-mannered children we blame the parents, not the children; on the dreadful

Yukon winter trail in 1900 some men maltreated and maimed their unruly dogs until the Northwest mounted police had to interfere, but more carefully selected dogs, showing all the eager soul that Maeterlinck imputes to them, came joyfully jumping around their better master, ready to die at his bidding.

The fair deal, based on the exclusion of the many, the selection of the few, must primarily spring from the master, not from the man. "With what measure the employer metes it shall be measured to him again, therefore all things whatsoever ye would that men should do to you, do ye even so to them." But mere kindliness of heart, mere desire to be fair, does not accomplish anything. Most boys would be better off in a severe school than under their loving, indulgent and weak mothers.

A railroad brakeman was put on the carpet by a superintendent. He came out from the ordeal and exclaimed: "That is the whitest man who ever lived." "Did he reinstate you?" asked his companions. "Reinstate me! No, he fired me; but he talked to me as if he were my father!"

In practice it is difficult to put up a fair deal unless there are three qualities, and these are rarely found in the same person. The qualities are sympathy, imagination, and above all a sense of justice. Though the combination is rare, the difficulty is not insuperable, for many men competent to be leaders through other qualities possess one or the other of the three essentials; and just as an illustrator, a story teller, and a book maker combine to bring out a great book, or even as two authors will combine like Erckmann-Chatrian, one of whom supplied the Gothic mysticism the other of whom supplied the Gallo-Latin lucidity and proportion for a series of great stories of the border land between Teuton and Gaul, so ought it to be possible to have one man, inspired with sympathy, furnish his altruistic dough; to have another man, inspired by imagination, mould it and bake it into bread; to have a third man, inspired by justice, carve and divide that bread so that each receives his own slice.

At Skagway in 1897-98 were many packers carrying the outfits of the northbound crowd over the White Pass. For ten miles out of Skagway the road was easy, and then for thirty miles over the pass and down the head streams to Lake Bennett it was desperately hard. After securing a contract the common run of packers had just enough imagination to move an outfit the first ten easy miles, there dropping it and returning for another cheap contract. The prices these near-swindlers received were low, since they bid against each other for an easy start, accepting from $0.08 a pound down to $0.04. They had no sympathy with the man whose goods they had dumped before the real work was begun; they had still less sense of fairness, anxious only to take money and not to perform the expected work. A type of a different kind was George Brooks who contracted to deliver outfits at Lake Bennett, 40 miles away, in 48 hours or no pay. George Brooks charged and received $0.20 a pound. He must have been a sympathetic man, for everybody liked him; he had imagination, for he knew that what the most eager men supremely desired was to make progress; and, charging the highest price he fulfilled his contracts. In spite of $0.20 a pound George Brooks was respected, honored, and even loved. In spite of $0.05 a pound, the cringing horde of near-packers was despised and loathed.

In the administration of Alaska from its purchase down to the present time, the fair deal has been conspicuously absent, individuals have been grasping, corporations intolerantly intriguing and oppressive.

Most good citizens desire to see smuggling stopped, desire to see natural resources conserved, desire to see Alaska well administered; but the great blunders of an ignorant and self-righteous officialdom at Washington and elsewhere which takes tithes of mint, anise and cummin and omits the weightier matters of the law, judgment, mercy and faith—which strains at a gnat and swallows a camel—make many a man regret that the opportunity of 1776 cannot recur. From the government down, through many of the great corporations and labor organizations, there has been conspicuous absence of the fair deal.

The successful gambler, the successful prostitute (history rings with the names and fames of both) succeed because they overbalance the hideousness of their callings with their appeals to the imagination, to the sympathies, to the sense of fairness. Let us therefore approach the principle of the fair deal with our imagination, our sympathies, our sense of fairness alert.

The great bulk of the population of the United States, both relatively and numerically, a hundred years hence will be descended from those who are the wage-earners today. Not dreadnaughts and fortified canals, but what our industrial officers make now of the working army, will make our future nation. The wage earners are our people and our nation; if not its backbone and skeleton, if not its brain, nevertheless its living flesh and blood. Moreover, the burden on them is both exalted and heavy. It is the men closest to their bread and butter who generally have correct instincts as to evils even if they often flounder as to remedies. It is the flesh that quivers with physical pain, not the brain nor the skeleton. It is on these workers that the duty devolves of bringing up respectable families on a small and precarious income. There is not room for all at the top, even if all were competent to climb, and one of the great problems is to make today bearable without taking away the hope of a better tomorrow.

Belief in eugenics is gradually extending. Great improvements in offspring having been obtained in a few generations, by carefully selecting and mating domestic animals and birds, it is contended that if the same restrictions were applied to human beings most of the evils to which humanity is heir could be expeditiously eliminated. There is, perhaps, much truth but also a triple fallacy in this theory. The sheep, the oldest of domesticated animals, has lost the power of self-preservation, and if man's protecting oversight is withdrawn the flock perishes. It is only on certain islands where there are no beasts or birds of prey, no poisonous weeds, an even and mild climate the year around, that sheep can survive unattended, until they destroy the grass blades and roots.

It has been proven again and again that thousand-year-old tendencies are not eradicated by a few generations of selection. In Darwin's experiment all widely divergent breeds of domestic pigeons reverted very soon to the wild blue-rocks from which they had originally been derived and been differentiated. Are we wise enough today to agree, much less really to know, what human traits ought to be perpetuated? The Latin often gives to certain instincts a charming bias, the Gothic gives to the same instincts a repulsive bias. The instinct itself cannot be judged by the coloring given it. It certainly would have been a pity in bygone æons to have perpetuated the good qualities of some *diplococcus* or to have suppressed as unpromising the idiosyncrasies of the original and very objectionable *pithecus erectus*. Therefore, firstly because we do not know and may select for preservation the poorest traits and for elimination the best; secondly, because our improvements are only skin-deep and transitory at best, and thirdly, because an immense amount of devoted effort in this direction will only produce infinitesimal results, we cannot hope for much from eugenics.

The case is quite different with the practical remedy of immediate common-sense selection. A man of sense has little difficulty in selecting the kind of horse he wants. If for his children, then a broad-browed, gentle, sensible pony able to take care of them; if for his own driving, then spirited, high-strung, fast, but not vicious travelers; if for the plow, medium weight, plodding animals without nerves; if for the dray, heavy slow animals.

The disposition of a horse or dog or cat can be told even by those with slight experience by merely looking at them. Avoid in the horse a narrow forehead, wide rolling eyes showing the whites, ears flattened back, bared and snapping teeth, nervous jerks.

In selecting human assistants such superficialities as education, as physical strength, even antecedent morality, are not as important as the inner aptitudes, proclivities, character, which after all determine the man or woman.

My own children showed in the first days of their lives well-defined traits of character that have never changed, whatever the differences of residence, climate, education or health.

The competent specialist who has supplemented natural gifts and good judgment by analysis and synthesis can perceive aptitudes and proclivities even in the very young, much more readily in those semi-matured, and can with almost infallible certainty point out not only what work can be undertaken with fair hope of success, but also what slight modification or addition and diminution will more than double personal power. Politeness, for instance, is an acquired accomplishment as distinguished from kindliness, an innate trait, but whole nations are polite and others boorish, and many an excellent man has made himself impossible because he was a boor.

The Tartar nomad who can see the moons of Jupiter with his naked eyes, to whom the sun, stars and moon are chronometer, almanac and compass, may think the earth is the center for the solar system, but he is more of an astronomer than the student who can calculate the orbits of comets but cannot recognize the Great Horned Spoon of our ancestors nor find the North Star.

The empiricist in outward signs of human character has, like the Tartar, splendid powers of observation, excellent judgment, and very valuable knowledge, but may lack familiarity with the conclusions of science based on very recent investigations. The modern brain student may be deeply versed in special lines yet lack practical familiarity with everyday manifestations.

The weakness of phrenologists, of craniognomists, of palmists, lies not in the fact that intuitionists and students are not able with almost unfailing accuracy to read aptitudes and proclivities, but that with insufficient experimental verification they have evolved untenable hypotheses. The theories as to the brain held by the old doctor who from a single tooth could give age, sex, disposition, and color of hair of the person to whom it had belonged, who from casual inspection of a letter held upside down at arm's length could give accurate description of the unknown writer as well as of her father, may have been crude, but he was able to read and understand what is hidden from most of us. The weakness of the scientific investigator who experimentally explores each part of the nervous system is that he fails to interpret the external signs. He is like the bacteriologist who knows the life history of comma bacillus but cannot read the evidences of tuberculosis in the human face.

It is of the utmost importance that there are specialists, a very few, who are supplementing intuition, observation, and good judgment with physiological, psychological and anthropological research and study and are thus able to give the most important competent counsel that can be given for both the fair deal and for mutual success, through advising both employer and applicant in advance of engagement whether the latter is or can possibly be fitted for the work that must be done. In the past, employers have recklessly engaged anybody, however unfit, and have then applied the remedy of reduction of wages or of discharge. The victims of this arbitrariness both in employment and in discharge have for protection joined unions, and influenced the unions to insist that wages per hour, not performance, shall be the unit, to insist that no equitable relation shall be established between work and pay, to object therefore to any determination or record of equivalency.

The horrible injustice lies not in establishing equivalency between pay and performance, which is as elemental as having accurate and certified scales in measuring the weight of what is sold or bought, but in retaining a man, whether by employer or by union, in a position to which he is constitutionally unadapted and for which he is unfit.

In a large plant there were thirty-six type-writing girls. One who had had three-years experience received on this account $12 a week. Another recently appointed received only $7 a week. They were both on the same work. Investigation showed that the $12 girl was able to direct 390 cards a day, that the $7 girl could, without injury and with leisure for rest, direct 1,800 cards. The $7 girl had keen perceptives, but no reflectives. She could by a single glance see and remember all the items on the card she was copying. The $12 a week girl had weak perceptives but fine reflectives. She had to read her copy word by word and item by item; she could, however, have written an excellent original letter as to the facts on each card.

Notwithstanding her protest and much to her immediate regret, she was taken off the work for which she was not fitted but to which she had given three years of preparation, and she was assigned to work for which she was fitted. The salary of the girl with perceptives and consequently capable of easy accomplishment was increased. The employer was at fault in assigning a girl to work for which she had no aptitude and which she never could do well and in keeping her on it for three years. The raises in salary, instead of being fair, added to the injury since they had the effect of confirming her in the belief that she was working along right lines.

Paying the competent girl with perceptives $7 a week because she was a novice was also unfair. The contention of the unions that the girl with perceptives should do no more in a day than the misfit senior, is equally unjust to both and damaging to civilization, since it prevents the misfit from taking any joy in her work or from rising to a higher level, since it prevents the adapted girl from earning what she deserves, and it lessens output and therefore increases costs by causing wastes of time in operators as well as in equipment.

In metallurgy the separation of free-milling ores from those that must be cyanided or smelted, the further separation of ores that have to be roasted from those that can be smelted without preliminary roasting, is both common-sense and the fair deal to the ores, to the treating plant, and to the mine owner. It is neither injustice nor discrimination most carefully to analyze, test, and sort those to whom must be entrusted the task of carrying on work of any kind.

In industrial plants on exactly the same work schedules, under the same foremen, under the same conditions and on similar machines, as to the same standards workers' efficiencies vary from 8 per cent up to 140 per cent. The 8 per cent men were overpaid for what they did, the 140 per cent men were underpaid; it would have been possible to fill the shop with men of the 140 per cent class and to have paid them 40 per cent more than standard earnings. No other direct act would have so added to contentment, happiness, freedom from trouble and cost reduction. The result could have been secured by the slow, painful, and expensive process of gradual elimination and selection, or it could have been in large part immediately, easily and cheaply secured through the employment of a competent specialist to advise as to aptitudes and character, with other examinations as to experience, skill, and disposition.

There are, of course, other phases of the fair deal.

Not only ought a boy apprenticed to a trade to feel confident that he has not been allowed to enter a race in which even before he started he was hopelessly outclassed, but he ought to see before him a reasonable certainty of tenure of position, of definite and increasing wages per hour until he has reached a maximum for his trade and locality; he ought to be assured of decent helpful companions; he ought to be certain that all those things essential to his health and safety which he cannot do himself are being done for him. As to the man, the worker, without whom industry would collapse, all conditions ought to be standardized. Drinking water ought to be germ-free, life-destroying dust should be sucked away, safeguards should surround moving machinery, work illumination should be adequate, not ruinous to eyesight. Working hours should be reasonable and without overtime except in great emergencies, means should be provided for ascertaining directly his needs, his wishes, of listening to his recommendations.

These general welfare considerations have their effect on the contentment of the worker and not one of them is recommended from any patronizing or altruistic motive. A locomotive or other machine is cleaned, housed, kept in repair, given good fuel and good water because its efficiency is thus increased; and in the interests of plant efficiency men should be treated at least as well as we treat machines. It is for mutual, not one-sided, benefit that the workers' counsel is considered.

For many years I was one of the army of workers for a great and progressive western railroad, the "Q" as we fondly called it. I was free to go at any time to the general manager and tell him what I thought of things, of the grade crossing here, of the freight rate that was driving farmers to haul their wheat in wagons instead of shipping it, of the frontier region that needed advances of seed if crops were to be raised the next season. I was one of many paths of communication between this great manager and the people who at once made his road and were dependent upon it. I then came east and lived on the greatest of eastern railroads. I tilted one dark night against the point of one of its crossing barriers. The hurt, severe as it was, enraged me less than the knowledge that I might as well try to change the position of the fixed stars as unofficially to induce a change in a crossing barrier.

Today when at one of the great railroad terminals in New York I walk carrying a heavy grip, 600 measured yards from front of station to car in which I am to ride; when I have to employ two porters, one a street rover to carry the grip 300 yards to the gate, the other a red-capped part of the organization to carry it the other 300 yards; when I am charged extra on every ticket on account of the privilege of using this palatial terminal—it is not these hardships and grievances that exasperate me, but the knowledge that countless millions of other travelers through all the years to come will have to submit unheeded to the same impositions which spring from lack of imagination, lack of sympathy, lack of sense of justice; and this insignificant matter becomes in the multitude the inspiration for an anti-railroad crusade for which the railroad officials are alone to blame—an anti-railroad crusade as to other matters, which would never have arisen if we could trust instead of fear, a hostility often as unreasoning as the little mistakes and injustices are senseless which stimulated it.

A great railroad superintendent of motive power now at the manufacturing head of one of the largest corporations told me that no unreasonable demand had ever been made on him by a labor organization that he could not trace it back to some act of petty injustice by a foreman of poor judgment.

A French Canadian worker at Montreal in a shop of mammoth proportions, fitted with latest machines, remarked with good-natured sarcasm: "It is to be regretted that the distinguished management has not considered it among its obligations to furnish such facilities as would make ordinary decency possible among its employees." Workers do consider and reciprocate as to high or low treatment, but it is not such questions as warm shops, clean towels, filtered water that most deeply and directly concern the man. He is willing to work in dripping and dangerous mines, to work in stifling sweat shops, to take his life in his hands every day provided the wages are tempting. It is about wages, directly or indirectly, that most serious disputes arise. When the French Canadians struck in this Montreal shop, it was not for facilities that would promote decency; it was for more wages, more pay.

It is for this reason that wages loom up as the most important question in industrial life today, although aptitude, therefore pleasure or success in the work undertaken, is more fundamental to individual, corporate, and national welfare. The individual is born with the instinct of self-preservation, of race-preservation, of acquisition and hoarding, the latter probably merely a specialized development of the squirrel's nut hoard, the wolf's buried meat. We have interposed the device of wages between basic need and its satisfaction. Wages therefore acquire the importance of both, and wages are also the cushion between anarchy and civilization. Men and women twenty-four hours without food become wild beasts; the human baby becomes fretful and then an anarchist if there is ten minutes' delay, instinctively knowing that nature gave it a mother able instantly to satisfy its craving. We have societies for the suppression of our natural instincts, societies for the prevention of cruelty, for the preservation of birds, for safety appliances, for art collections and for libraries; we have in our legislatures endless debates over insignificant matters; but where is there any rational study of wages, much less any society to enforce fair wages or any legislation in favor of fair wages? Labor unions use the big stick to force wages up, employers make secret combinations to keep wages down, as if a clock, either too fast or too slow, were not equally unreliable.

No other subject is so disturbing as wages, or requires so much of the "fair deal." If plans for wage amelioration, successfully tried on a large scale, have been at best only experimental, they at least have interest as showing how this delicate subject was approached with the fair deal in mind.

The worker wants as high pay as he can enforce; the employer wants his output to be as cheap as that of his competitors, for if it is not he will be driven out of business. The worker cannot be expected to work for an employer for less pay than is paid under similar conditions for the same class of work by another employer. The wage payer cannot be asked to pay higher wages than the current rate. Because this question is a dangerous explosive, because any stray spark, concussion, or blow may set it off, it should be as far as possible standardized and nine-tenths of the opportunities for clash be eliminated.

As at present paid, wages come neither under status, contract, nor individual effort. Like many other innovations, wages have preserved some of the worst features of all three systems and avoided the best.

The worker is in status when he comes, stays, and goes under the orders of the employer. There is, however, no status when he is laid off without pay or his hours are cut down. He contracts his time for a fixed sum per hour, but he does not, like other contractors, agree to deliver any equivalent in output for the pay received. On day rate and even on piece rate he cannot use individual effort to increase indefinitely his earnings. He is partly a partner since the machines belong to the employer.

Piece rates have offered no solution. They were tried in order to abolish status and substitute contract and individual effort. Status cannot be wholly abolished. A shop is more highly organized than a flock of sparrows or gulls. There must be regular hours, there are so many dependent sequences that individuals must conform to the general plan. A piece rate is, however, an endeavor to establish an equivalent in output for money paid.

If a man's wage rate is $0.30 an hour, if it is estimated or guessed that he can do a certain piece of work in an hour, a piece rate of $0.30 is established. He is told to go ahead on the supposition that he will earn more than $0.30 an hour. The employer would be very careful how he attempted to reduce the $0.30 rate per hour, but if he finds that the worker earns $0.50 an hour he immediately begins to scheme to reduce the piece rate.

When high-speed steel began to come into use, the machine shops at Roanoke of the Norfolk & Western were on piece rates under an agreement. Although the use of high-speed steel on modern wheel lathes has reduced to one hour the time of tire turning which was 18 hours with carbon tools on an old lathe, the machinists refused to permit readjustment of the rates.

It is evident that piece rates installed twenty years ago must be inequitable today.

On the one hand, wages have risen with the increased cost of living. On the other hand, improved facilities have greatly increased the ability to turn out work. Piece rates must necessarily be readjusted and their readjustment is one of the industrial tugs of war.

As to this most delicate of wage questions, peace and harmony have followed the following fair-deal provisions:

1.—Decimal wage rates per hour are established.

2.—These decimal wage rates run as local conditions require, from $0.20 an hour down and up in full two-cent intervals, therefore $0.16, $0.18, $0.20, $0.22, $0.24, $0.26, etc., perhaps down to $0.06 and up to $0.60 or more.

3.—The wage rate at which a man is engaged or retained is subject to negotiation and agreement between him and the employer.

4.—Men shall not be required to work over ten hours a day without a bonus.

5.—Normal hours shall be nine a day.

6.—A time equivalent shall be determined for every operation.

7.—No worker is under any obligation to attain the time equivalent. His wages do not depend on it, but on the time he is under orders.

8.—Time equivalents are subject to revision either up or down as conditions change, never because of high individual skill.

9.—Revision is made by competent disinterested specialists and both parties know why, when, where, and what revisions are made.

If all these provisions are part of the standard practice of the shop, if they are accepted when a man contracts his time, serious disagreements can arise only as to (3). It is inevitable that wages will from time to time rise or fall, partly because of varying cost of living, partly because of supply and demand. In certain districts in Alaska, owing to both causes, wages have been as high as one dollar an hour, and when the Klondike gold rush began, nearly all the miners at the great Treadwell Mines near Juneau took French leave. They made no demand for higher wages, realizing that an increase could not be granted, and what they wanted was not an increase of 10 per cent on a $0.30 rate, but a chance to earn $10 to $15 a day.

Standards could, to a large extent, automatically govern promotion from one class to another on account of gain in experience, increased age, or meritorious record. A time ought to come when a wholesale advance or recession in basic rate could be referred to arbitrators or advisory commissions so as to minimize opportunity for disagreement.

In one plant the following plan is successfully operated. A man capable of realizing 100 per cent efficiency is rated at $0.28 an hour, and if he attains this efficiency he is given in addition 20 per cent bonus. If he can only realize 60 per cent efficiency, his wage rate falls to $0.20 and there is no bonus. If he delivers 80 per cent efficiency the hourly rate rises from $0.20 or it drops from a previous $0.28 to $0.26 an hour, and the bonus becomes 3.25 per unit.

Competition and trade conditions do not permit a rate of $0.28 for an efficiency of only 60 per cent, but owing to the saving in overhead charges costs do permit an increase of 68 per cent in pay for an increase of 66 per cent in work. On the other hand, workers in this particular trade feel entitled to a basic rate of $0.28, a rate that ought to be paid if the workers are as competent as they claim.

The other eight provisions are almost self-evident. Undecimal rates, as 19 4/9 cents ar hour, are an abomination and without permanent excuse. At one great establishment where the efficiency of the men in many instances was below 50 per cent, where it averaged no higher than 60 per cent, where an increase in efficiency of 20 per cent was attainable, the most strenuous and indignant objections were made to standardizing this rate at $0.20. Rates of $13.50 per week divided by 56 hours to find the hourly rate are also an abomination. The greater accuracy of records and the greater accuracy of supervision far more than offsets the slight cost of standardizing upwards irregular rates, even in an old shop.

Since the United States adopted a decimal dollar, I believe in 1804, it does seem ridiculous constantly to revert to quarters and eighths of dollars, or to advance a man a half-cent per hour, or, what is worse, give him an increase of $0.25 a day for a nine-hour day. Calculating machines, wage tables, are only half as large on a $0.02 interval basis as on a $0.01 interval. If a boy is advanced from $0.10 an hour to $0.30 in ten years he can just as well be advanced in two-cent steps as to be advanced in one-cent steps, and the advances can be so timed as not to decrease his aggregate earnings.

It is conceivable that a man working 8 hours can do a full rational day's work. The same work could be done with less wear and tear in 9 hours. Would I prefer to walk 3 miles an hour for 9 hours, or to walk 3.375 miles an hour for 8 hours? I think I might prefer to walk 2.7 miles an hour for 10 hours. A normal work day of 9 hours with temporary variations in gangs between 8 and 10 hours has been found to work well. If, in balance with the shop, a ten-man gang is working 9 hours a day and one man drops out, until he returns or can be replaced the gang must either work harder, work longer, or disturb the balance of dependent work. Rather than drive harder it is more equitable to pay for the extra normal time required.

Longer hours than 10 are wholly deleterious to both worker and shop. I never knew any advantage to result from promiscuous overtime. It should always be a serious emergency resource, and the bonus should be very high to men, the loss of shop efficiency and increased cost be brought home to each official.

The time equivalent for every operation is the key that eliminates misunderstandings. All the great exchange business of the world is today done on a basis of equivalency. A bale of cotton, a bushel of wheat, is standardized at so many pounds and the dollar is standardized at so many grains.

The worker is selling time, just as a coal-mine operator sells coal; but the purchaser is not buying time nor coal; he buys output and heat units. The equivalency between operation and time (not wages) is of transcendent importance, exactly as equivalency between heat unit and fuel is of importance. Happily both can be scientifically and accurately determined, and even if we never realize the equivalent, the starting point for our modern engines and their improvement over their prototypes of fifty years ago is that we know that 776 foot pounds are the equivalent of an increase in temperature of one degree F. of one pound of water.

No maker of an engine is under obligation to realize this equivalent. Neither is any worker under any obligation to attain a time equivalent. His wages do not depend on it. He is paid just the same whether he ever realizes a single equivalent, even though in every case the equivalents are normally attainable under standardized conditions and standardized operation. One hundred yards in ten seconds is not a normal equivalent; four miles for a single hour, twenty miles a day for six days each week, are normal equivalents.

Owing to changed conditions, never owing to wages, equivalents to remain fair equivalents must be revised. When a miner of precious ore wishes to sell, when a smelter wishes to buy, neither takes the word of the other. Both employ skilled and certified assayers who assay from the same sample of the ore and determine its value, and if they do not agree other assays are made; on these scientific assays millions of dollars are paid out with never a question or dispute. If accounts between two mercantile firms are muddled, a certified accountant is called in who unravels the truth and on his statement settlements and even court awards are made. Similar revision of equivalents, although no wage rates are involved, should be made by scientific specialists, employing scientific methods, revising solely in the interest of accuracy and truth, never to give either party an unfair advantage. All these provisions have been applied, and applied successfully, on a large scale if not completely all in the same plant. They have worked as intended, they have eliminated wage disputes and wage disagreements, since the inculcated habit of fairness has reacted on the basic wage question and the employer particularly has proved willing without demand to raise the basic rate. The vice-president of a great railroad system of 10,000 miles who has applied many of these provisions to the wage question states as one of his guiding principles that if other roads in his territory increase rates so as to equal his rates, he will at once make a readjustment upward of the basic rates in order to maintain a differential in favor of his employees.

What wages buy is fully as important as the rate. It may be well-nigh impossible to force wages up 20 per cent but, it is well known that a French family can live in plenty on what an American family wastes. I know a man, now a millionaire, who at the age of thirty-five was still working for $40 a month as a beef carrier in Chicago. He saved money and bought a farm, sold the farm and went into the milling business. I know another man, now a millionaire, who started as a carpenter, built breweries, saved money until he had a brewery of his own. I know a young man now chief assistant to the executive of a great plant. On a salary of $30 a month he married a thrifty Scotch lassie and the dimes they saved from the start seemed as large as cart wheels.

If the American worker would put efficiency into his family expenditures his income would go 50 per cent further. It is unfortunate that he concentrates his attention on rate of wages instead of on the equivalent he is giving the employer. It is unfortunate that the employer shies at the suggestion of a 10 per cent advance and pays scant if any attention to a 50 per cent inefficiency, two-thirds of which is his own fault. The combination of thrifty worker, high equivalent, fair-minded and progressive employer, wages far above the average, insures lowest costs, just as certainly as piano wire at a high price per pound will make a stronger, longer, bridge than cast iron at one cent a pound.

Like the other efficiency principles the fair deal should be standardized; it should be moulded by each of the other eleven; it should be under the particular care of a very competent staff official, aided and assisted by many specialists, character analysts, hygienists, physiologists, psychologists, bacteriologists, safety-appliance and light and heat engineers, economists, wage specialists, accountants and lawyers—in short, by all the available and applicable knowledge in the world. Provided for in the organization, founded on ideals, on common-sense; developed by competent advisers, simplified by vigorous exclusion of the unfit, the unfair, it should be carried into effect through reliable, immediate and adequate records, through standard practice, definite instructions, through schedules and through all the other efficiency principles.

The fair deal is the last of the five altruistic principles, principles so fundamental that we find them applied by a she-bear to the bringing up of her cubs; principles inculcated by Old and New Testament, by every great religion.

The object of collating wise practices of administration under a few simple heads is that each may regularly survey his own task from the point of view of each one of the principles, and thus not only prevent the backsliding that ultimately results in disaster, but make forward progress so that he who started as a disciple soon becomes a master to whom we turn for competent counsel.

Other five principles, (therefore not including standardized operation and efficiency reward,) are not practiced by the she-bear, are very inadequately inculcated by the great religious teachers.

They are as modern as the gas engine, the dynamo, the steam turbine; they are almost as modern as the flying machine; they are evolved to cover modern complex conditions. The sequence in which they will be discussed is not essential. Records will be first considered, but records can be neither reliable, immediate, nor adequate until nearly everything else has been standardized. The subject of records will therefore, of necessity, be treated theoretically, showing at least the backbone of essential records from which less essential records spring like ribs. There are records of standard condition, of standard operation, records of discipline and records of the fair deal; but the essential records of cost and efficiency will be developed from an underlying, universal and exceedingly simple formula, which covers operating efficiencies and standard operating costs of materials, of men, and of installation.

VIII

THE SIXTH PRINCIPLE: RELIABLE, IMMEDIATE, ADEQUATE, AND PERMANENT RECORDS

The potter sitting at his work, turns the wheel about with his feet; he is always carefully set to his work, and maketh all his work by number.—*Ecclesiasticus*, 38.

Where there are many hands, deliver all things in number and weight; and put all in writing that thou givest out or receivest in.—*Ecclesiasticus*, 42.

Chapter VIII

THE SIXTH PRINCIPLE: RELIABLE, IMMEDIATE, ADEQUATE, AND PERMANENT RECORDS

WHEN a child touches the red-hot end of a poker, the information, advice, notice, record is reliable and lasting, also immediate and adequate. The scar is a perennial reminder of the mistake. Many of Nature's warnings are reliable, immediate, and permanent; they reach us and other animals through the senses—we hear, we see, we smell, we taste, above all principally, we feel. There are two nerves from the brain to the eyes, two to the ears, two to the nose, two to the palate; there are several hundred between body surface and brain. Very few people allow themselves to be burned, because the penalty is reliable, immediate, and adequate; but they are not as shy about more deadly disease germs (probably a thousand people die of tuberculosis for one who is burned to death) because the result is not reliable nor immediate.

The object of records is to increase the scope and number of warnings, to give us more information than is usually received immediately through our senses. A steam boiler with water in it, a fire under it, and all outlets closed, is more dangerous than a hot poker. There is very little to indicate the imminence of disaster. It is too hot to touch with the hand, although it is conceivable that a spot in it might be so insulated as to permit the engineer to tell by feeling whether it was becoming too warm. A thermometer would give a better record; but usually there are three recording instruments, each reliable and immediate, one of them in addition adequate. The engineer watches his pressure gauge, he watches his water-level glass, and the safety valve will pop even if he has fallen asleep. It is because of these three devices, one of which is independent of the man, that there are so few boiler explosions. All around us are many natural forms of advice, of *records*—the word is throughout used in its largest sense.

The object of records is to annihilate time, to bring back the past, to look into the future, to annihilate space, to condense a whole railroad system into a single line, to magnify the thousandth part of an inch to foot-rule measurement, to gauge the velocity of a distant star by the shifting of the lines in the spectroscope, to annihilate temperature by enabling us to read the millionth of degree or the 10,000-degree difference between moon and sun heat.

Animals make and use records, reach out to each other through time and space; and the naïve surprise of the doe when the stag appears does as much credit to her modesty as the trail of musk left in her footsteps along many miles and for many days does credit to her involuntary common sense. Man alone reaches out to man through millenniums; and the pictures carved in stone, the hieroglyphics pressed in brick or cut in granite, tell us more about the intimate lives and philosophies of the Hittites, of the Egyptians, than we know of our own immediate ancestors, the Germans or the Gauls—than we know of our immediate neighbors, the Indians. Pictures and writing were a great invention; the reducing of music to written form so it could be reproduced was even more marvelous, since through the eye we recreate for the ears, thus bridging the gap between the senses. The perpetuation of sound through ages in the phonograph disk, the perpetuation of movement on a long film, these are part of man's triumph through records. The phonograph disk is, next to the brain, the most marvelous, if not the most useful, record man possesses, since all the throbs, moans, triumphs, all the *nuances* of a hundred instruments and of a hundred voices, pulsations of the air, are recorded by the needle point in a microscopic line; and that line, that perfect record, gives us again the same air pulsations, the same great instrumental and vocal chorus.

Records are anything that give information. Men have always felt the need of records, but they have not always known what they wanted nor how to secure them. In the great industrial plants one knows not whether to marvel most at the absence of reliable, immediate, and accurate records, or at the superabundance of permanent records, collected with painstaking and at great expense, but neither reliable, immediate, nor adequate. Even if the latter have all these qualities, there is often great duplication, and as a consequence we find an immense amount of accumulation of very little value, which has cost far more than it need. An example of duplication may be found in the coal records for locomotives. Expenses of operating locomotives are generally recorded per mile, but suddenly a parallel set will crop up showing miles run per ton of coal. It has not been unusual in a great corporation's records to find a great variety of monthly tabulations, and when inquiry is made it is finally unravelled that twenty years before some president wanted a certain set of records, that his successor wanted a different set, which were started in parallel, that a third and fourth incumbent added their requests, but the old tabulations continue to be made and painstaking clerks work their monotonous lives away in neat compilation that no one has looked at, much less used, for a decade.

When the tramp piled and repiled the same cord of wood first on one side of the yard, then on the other, he was working efficiently but to no purpose; and having the soul of an artist he finally rebelled.

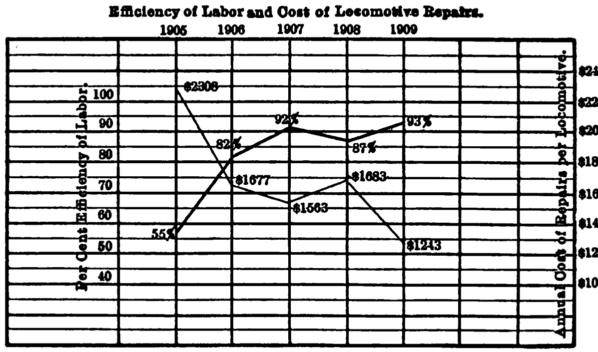
A clerical force may be hard at work, but it may accomplish very little and in the larger acceptance of the word it is inefficient, even as a hard-working steam engine using 50 pounds of steam per horse-power hour is inefficient in spite of its diligent consumption of coal.

There are records of all kinds, many of them essential to our continued existence. There are in a much more limited way records of cost; and between the two extremes of universal records (as the swing of the earth in its seasons or the slow aging of every living and inanimate thing) on the one side, and cost records on the other, come records of efficiency, and these are what we particularly need in the present phase of industrial life. We have not yet learned to use to any great extent the conception of efficiency. We are interested in what eggs cost per dozen, not in the weight of each egg; we ask the price of coal per ton, but rarely know whether it contains 10,000 or 15,000 heat units per pound; we violently resist a demand for a 10 per cent increase in wages, but we tolerate a 50 per cent inefficiency in the worker. Not one in ten thousand knows even approximately the cost of food. Its price is known, but not its value, and if a curve of food values per pound should be drawn, and above each item its price, the line would look like the record of the seismograph during an earthquake, or the record of a magnetic needle during an eruption on the sun.

The whole United States was frantic in 1896 over the money question, and not one in a thousand of the gold advocates knew that owing to violent fluctuations in supply and use gold had varied in value more than any other staple, not from hour to hour, as gold bonds and gold stocks fluctuate in value on the stock exchange, but from decade to decade. One of the tasks of modern scientific management, of efficiency and standard-practice engineering—two names for the same ideals—is to convert efficiency records into cost records, since the language of costs is understood by all, the language of efficiency only by the few. It is, of course, generally true that costs will decline as efficiency increases, but this is not always so.

A jeweller may work with the same efficiency setting on one day a $2,500 diamond in a gold stickpin and the next day setting a $0.25 bit of glass in a brass pin. Costs have varied, but not efficiency. A Japanese miner may work for $0.20 a day and an Alaskan miner for $15.00 a day. Each may work with equal efficiency, but the cost is very different. On the other hand, a farmer, from the same field, planted to the same crop, plowed by the same man, team, and plow, raises increasing crops of the same grain; but wages, land values, and the price of horse feed might also increase so that decreased cost will not always directly flow from increased efficiency.

In the refinement essential for the control of modern operations, it becomes increasingly necessary to state efficiencies even if we talk costs.



	1905	1906	1907	1908	1909
Average wgt. of locos.	75.63	79.50	81.74	82.98	82.98
Mileage per loco. failure	3160.	4900.	4250.	4641.	6200.
Tonnage hauled per loco. mi.	685.	725.	765.	770.	796.

The Engineering Magazine

RECORD OF EFFICIENCY AND COSTS IN LOCOMOTIVE REPAIRS

As a contribution to the solution of this problem a universal formula of cost and efficiency has been evolved which has the further advantage of showing what records are really essential and necessary, what form they ought to take and what records are useless, confusing, and to be omitted. All the necessary reliable, immediate, adequate, and permanent records can be obtained and maintained for less expense than is usually incurred for misleading, delayed, inefficient, and ephemeral records.

The costs of modern operations consist of three elements. For instance, in a recent year it may have cost to operate all the railroads of the United States approximately:

For materials	$ 524,000,000
For personal services	1,021,000,000
For interest, depreciation, and other capital charges	1,210,000,000
	$2,755,000,000

Omitting millions, we can set up the formula:

Total cost	=	Material	+	Per. service	+	Invest. charges
2,755	=	524	+	1,021	+	1,210
C (actual)	=	M (actual)	+	S (actual)	+	I (actual)

Let us assume that extended investigations show very inefficient use of materials, very inefficient use of personal services and also over-equipment, and that from a practical point of view it might be possible to accomplish the same general result with $370 of materials, $780 of personal service, and $600 of investment charges.* The formula of standard cost then becomes:

* These figures are used only for illustration, not as the expression of a conviction.

$$\underset{\$1{,}750}{\overset{\text{C}}{\text{(standard)}}} = \underset{\$370}{\overset{\text{M}}{\text{(standard)}}} + \underset{\$780}{\overset{\text{S}}{\text{(standard)}}} + \underset{\$600}{\overset{\text{I}}{\text{(standard)}}}$$

The efficiency of the whole operation is:

$$\frac{\text{C standard}}{\text{C actual}} = \frac{\$1{,}750}{2{,}755} = 63.5 \text{ per cent.} = \text{Total efficiency} = \text{E}$$

The relation of standard cost to actual cost gives the efficiency. This can be applied to each sub-parts:

$$\frac{\text{Material cost standard}}{\text{Material cost actual}} = \frac{\$370}{\$524} = 70.6\% = \text{Material efficiency}$$

$$\frac{\text{Labor cost standard}}{\text{Labor cost actual}} = \frac{\$780}{\$1{,}021} = 76.4\% = \text{Service efficiency}$$

$$\frac{\text{Investment cost standard}}{\text{Investment cost actual}} = \frac{\$600}{\$1{,}210} = 49.6\% = \text{Investment efficiency.}$$

Actual costs can next be stated in terms of standard cost and of efficiency:—

$$\text{Total actual cost} = \frac{\text{Total standard cost}}{\text{Total efficiency}} = \frac{\$1{,}750}{63.5} = \$2{,}755$$

$$\text{Total actual cost} = \frac{\text{Standard cost of material}}{\text{Material efficy.}} + \frac{\text{Standard cost of service}}{\text{Service efficy}} + \frac{\text{Standard cost of investment}}{\text{Invest. efficy.}}$$

$$\text{Total actual cost} = \frac{\$370}{70.6\%} + \frac{\$780}{76.4\%} + \frac{\$600}{49.6\%} = \$2{,}755$$

If we know in advance the standard or theoretical costs, if we know the current efficiencies, we can predetermine actual costs. What we all desire is to make the industrial machine as efficient as possible, to bring efficiencies up to 100 per cent, and when we do this actual costs will be the same as theoretical costs. We must first attack the problem theoretically. We must have standards and we must have efficiencies. When a pump or steam engine is tested, by every means we ascertain ideals; we then compare actualities with the ideals and we ascertain efficiencies. Similarly, in the great industrial problem we set up ideals, we measure against them actual performance, and we ascertain efficiencies, and as for pumps, and for steam engines, so also do we use these efficiencies to prophesy future costs.

When actual and ideal performances are both recorded the relation in one month will generally serve to predetermine efficiencies in the next month, the relation of one year to predetermine efficiencies in the next year.

The elementary formula is, however, wholly inadequate for a real determination of efficiencies and has in fact led to most serious misconceptions and consequent mistakes.

Reference has already been made to the folly of the man who buys coal by the ton without knowing whether it contains 10,000 or 15,000 heat units per pound, who scrutinizes the cost of personal service without knowing its quality, invests in new machinery without counting its hourly cost, or without being able to keep it busy.

The cost of materials depends on two factors, the quality and the price.

Material cost=Quantity of units at price per unit.

$$M_c = Q_m \; P_m$$

What is wanted is that QP shall be a minimum cost.

The usual impulse and plan is to attack the price, P. This does not work. It is almost impossible to lower price, yet maintain quality. There is a constant demand for better quality and the tendency of prices is upwards. In the last ten years railroad presidents would have had great difficulty in buying steel rails at less than $28 a ton. Q, quality, is the important factor. There is almost no limit to the reductions that can be made in quantity. Let us take coal as an example. The ordinary industrial-plant furnace, boiler and engine, use five to seven pounds of coal per horse-power hour.

By buying better coal, better furnace, better boiler, better engine and better service, coal consumption can be reduced to two pounds, in some instances to one.

Efficiency of production of power as to material is raised from 14 to 40 per cent up to 100 per cent. The distribution of power may, however, be very inefficient. Air, water, and steam pipes may leak, there may be seven voltage drops in electric transmission. For 100 horse power produced in power house only 80 may reach the places of use. There is usually great waste in the use of power; lights burn, pumped water is wasted, steam blows through steam hammers, compressed air is used to ventilate rooms or blow the dust out of clothes. The efficiency of use is rarely above 70 per cent. Assuming the efficiency of production to be as high as 70 per cent, that of transmission as high as 80 per cent, that of use as high as 70 per cent, we have an end maximum efficiency of 39.2 per cent. If, as often happens, productive efficiency is as low as 14 per cent (the air-brake pump uses about 200 pounds of steam per horse-power hour), if the efficiency of transmission is as low as 60 per cent (I have known power steam pipes to be laid unlagged through running brooks), if the efficiency of use is 30 per cent (cities where water is metered use only one-third as much as those where it is furnished without check as to quantity), then the end efficiency of 14 per cent production, 60 per cent transmission and 30 per cent use is only 2.52 per cent. It is not because of price, but because of the dependent sequence of inefficiencies in quantity that QP usually admits of such very great reduction.

$$\text{Materials actual} = \frac{Q_{st}\ P_{st}}{EE'\ E''_{mq}\ \ E_{mp}}$$

If EE′E″ is only 2.5, P_{st} could be increased 40 times without adding to cost, but a comparatively small increase in P_{st} doubling it for instance, may be the easiest, quickest and most economical way of increasing $EE'E''_{mq}$ to 10 per cent, 40 per cent, or even 90 or 100 per cent, as the case may be.

Therefore, in the last generation railroad executives were willing to pay more for steel rails than for iron rails, fuel consumers are willing to pay more per ton for oil than for coal, bridge builders prefer expensive wire rope to cheap cast-iron, for in each case as quality goes up, quantity goes down much more rapidly. What is true of materials is equally true of personal service. Labor, like material, consists of both quantity and quality. The quantity of labor is measured by time, its quality by what it accomplishes. The formula for personal service becomes.

S=time in hours multiplied by wages per hour
S=TW

When TW seems too high there is generally an insane desire on the part of those in control to reduce W. This is naturally resisted most strenuously by the wage earner. As in materials, it is not the price of the unit per hour that counts, but the quantity used. Also as in materials, there are inefficiencies of initial quantity, inefficiencies of distribution, and inefficiencies of use. Let us assume schedules of different rates of pay for different classes of workers. I have known industrial plants to engage 600 men when 300 would have been sufficient; I have known 12 men to be assigned to a job that 2 men could have done. There is inefficiency of initial quantity of 50 per cent to 17 per cent.

I have known men that ought to have been earning $6 a day, in reality earning only $3 because they were in the wrong place, paid $3 for work that a $1 a day boy could have performed better; I have known a $75 a day expert to be kept busy on clerical work that could have been done better by an $18 a week clerk. These are examples of inefficiency of distribution, varying from 17 per cent down to 4 per cent.

The inefficiencies of use are so tremendous that their cause has to be explained. Up to about a hundred years ago, with the exception of a few windmills, a few sailing ships, and a few cumbersome water wheels, all the work of the world was done by the muscular energy of man and animal. It was used fairly efficiently, often strenuously. I have been fortunate in seeing and experiencing personally much of what was formerly the rule, as the porterage of freight and supplies over the Chilcoot pass on men's backs, 100 pounds to the man, and the killing, by overwork, of 3,750 horses out of 3,780 in the awful strenuousness, but lamentable inefficiency, of the White Pass pack trail in 1898.

The discovery that we could use coal, oil, gas, mountain water-powers as sources of energy has changed all civilization. In the United States alone we have per inhabitant twenty times as much energy available as when I was born. The man whose manual labor it would take for over 500 years to spade up a section of unbroken prairie land, is quite inclined to think that he is using his time very efficiently if with team and plow he breaks up 640 acres in four years, when in reality with suitable equipment, mechanical tractors and gang plows, it could be done in 36 hours.

The man who would take a week carving by hand a small frame, might pride himself on turning out one frame a day with foot power, when in reality with moulds and automatic machinery he could turn out one frame a minute.

If, as I have seen, a man using a shaper overruns the necessary stroke three-fold, if the machine's speed is only 30 per cent of what it ought to be with modern steels, if his feed is a 1/64 inch instead of a 1/16, if he takes four cuts instead of two, then his end efficiency is only 1.25 per cent. Men have not yet realized that the ages of muscular effort are passed, that work can no longer be measured in manpower or foot-power, that we no longer want the man who can spade twice as much, the man of burden who can carry twice as much, the man who can break a horseshoe with his bare hands; but we want the man on the bridge of an oil-fired steamer, we want the crew of an oil-fired locomotive, engineer on one side with hand on power-moved lever, fireman on other side with finger on oil valve; we want the crew of mechanical tractors and gang plows, each man directing and superintending the evolution of as much uncarnate energy as 2,000 men could have evolved using man-incarnated energy.

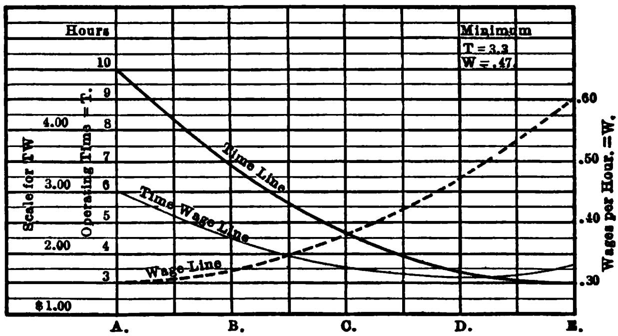
Assuming as a possibility in inefficiency of labor a quantity of 50 per cent, of labor distribution of 17 per cent, of labor use of 1.25 per cent, we have an end efficiency of 1/5 of 1 per cent. I have seen worse happen than this, for sometimes the worker did nothing at all, at other times was busy on wholly unnecessary work. As a general average, efficiency of supply of work is not over 90 per cent; efficiency of distribution, if fitness for the work is included, not over 60 per cent, and efficiency of use not over 70 per cent, giving an end efficiency of 37.8 per cent, shading off from this maximum to nothing.

As to service, therefore, as in materials, it is quality that ought to be improved by paying a much higher price per unit. It is not more strenuousness that is wanted; it is more efficiency with less effort. As T goes down, W must go up both relatively and directly. The locomotive engineer is paid higher wages than the Chinese coolie, and as part of his daily life he enjoys luxuries unknown to kings a generation ago, still unknown to Chinamen. The coolie carries 150 pounds 20 miles in a day; the American locomotive engineer and the fireman haul 6,000 tons 60 miles a day. Piece rates are physiologically and equitably vicious and wrong. They put a premium on harmful strenuousness, instead of standardizing conditions and operations so that greater output will follow less effort, but higher efficiency per unit of time; they are based on the assumption that output is dependent on muscular energy as it was in former ages, instead of being dependent on a steadily increasing quantity of uncarnate energy, combined with a steadly increasing quantity of incarnate energy, both directed by a steadily increasing intelligence.

T cannot indefinitely decrease, neither can W indefinitely increase, and experimentally we must determine what combination of TW results in minimum cost.

In the diagram on page 224, the vertical lines A, B, C, D, E are records of different men working on similar jobs but at different rates of

TW Should be a Minimum



TW.	T.	W.	Total.	
A	10.00	.30	$ 3.00	
B	6.85	.32	$ 2.192	
C	4.60	.38	$ 1.748	
D	3.30	.47	$ 1.551	Minimum
E	3.00	.60	$ 1.80	

The Engineering Magazine

EFFICIENCY DIAGRAM SHOWING RESULTS AT VARYING COMBINATIONS OF TIME USED AND WAGES PER HOUR

speed. A, the slowest worker, takes 10 hours to accomplish a task. His speed is that of a lame man only able or willing to walk a mile and a half an hour. Nevertheless, although he may be wholly unfitted for the work and the work not suited to him, he has to live, has probably a family to support, and he is unwilling to work for less than $0.30 an hour, and if he is wise, joins a union which will enforce this minimum rate. A's standard expenses probably eat up 90 per cent of his earnings, or $0.27 per hour, his profit above expenses being $0.03 per hour. B is a faster worker, able to walk 2.2 miles an hour. He is also given $0.30 an hour, but in view of his greater speed an extra payment of 6.6 per cent is added, making his hourly rate $0.32. His living expenses, as for the other man, being $0.27, his net earnings or profits become $0.05 per hour as compared to $0.03. He has increased his profits 66.6 per cent. The man C is one who can and does walk at the rate of 3.3 miles an hour, a mile in 18 minutes. This man earns $0.32 in wages and a bonus of 20 per cent, making his hourly earnings $0.38. His net profit above minimum living cost of $0.27 is $0.11 an hour, or an increase above A in net profits of 267 per cent. D is a man who can walk 4.5 miles an hour, or a mile in 13.3 minutes. This is fast walking, but not as fast as is regularly kept up hour after hour and day after day on the Yukon if the trail is good.

D earns $0.15 an hour above the employer's basic rate of $0.32, his profit is 400 per cent more than that of A. This man's speed is the most economical both for the employer and for himself. A speed greater than 4.5 miles an hour is more than the normal man ought to keep up. E is an abnormally fast traveler, running at the rate of 5 miles an hour, the Yukon average. His pay rises to $0.60 an hour, his profit to $0.33 an hour, the profit alone being more than the wages earned by A or B. His profit is 1,000 per cent greater than that of A.

E is a strenuous but not an efficient traveler. His work costs more than that of either D or C, and he will break down if he long continues the pace. If greater speed is wanted the method must be changed, not the strain increased.

$$\text{Actual service cost} = \frac{T_{st} \quad W_{st}}{E'_t \; E''_t \; E'''_w \; E''''_w}$$

W must increase as E_t increases, W must fall as E_t falls. If this is not the law, then there is no hope ahead, and civilization, discovery, and appropriation of the energies in the universe are disasters. But it is the law. Let us illustrate by a single example. Sixty years ago $5 of free gold to the ton, $100 of combined gold to the ton, were about the lowest amounts that it was profitable to work.

The average rate of wages for white men was low. The time efficiencies of gold production have been steadily improved, gravels are now profitably washed that contain as little as $0.05 to the ton, ores are mined and smelted that contain as little as $5 to the ton. Gold production has increased from $13,500,000, the average before 1848, to $400,000,000 per annum. White men's wages have doubled and 250,000 men are now employed instead of 12,500 as formerly. Those who made money from owning gold mines have invested it, developing other industries, creating still further demand for employment. Let us assume that the gold producers of the world should unitedly demand a 2-hour day at the same wage per hour, instead of the present 8-hour day, on the supposition, firstly, that they would thus provide work for four times as many men, and that a larger proportion of the output of the mines would go to labor. The immediate effect would be the closing down of nine-tenths of the gold mines of the world, 225,000 men would be thrown out of employment, other industries would be curtailed, still further increasing the supply of labor. The 2-hour provision might stand, but either wages would drop until low enough to make the reopening of the mines a paying proposition, or increased efficiencies would have to be applied to mining so as to increase the output fourfold per man-hour of work.

More than ever before would it be necessary to make motion studies and time determination and to set up standards of supply, of distribution, of use as to every item of work. If wages per hour are arbitrarily increased, the increase can be safely provided for by increased efficiency, and in no other way. If efficiency is arbitrarily increased, wages will inevitably rise, or effort will diminish.

What is true of materials and personal service is equally true of investment charges. Investment charges, like personal service, fall into *time* for any performance and the cost *per hour*.

$$I = T'R$$

in which T′ indicates time in hours and R cost per hour for capital charges.

If all the railroads of the United States are worth $14,000,000,000, it is evident that the annual capital charge for interest, depreciation, insurance and taxes might be $1,000,000,000—that the actual capital charge per hour is $114,155. If, therefore, as a token of respect to the memory of a dead president, all railroads should stop operations for 10 minutes at the time of his funeral, the cost would be about $20,000 in decreased efficiency of R, but the officials would hasten to make it up by increasing the output of the subsequent hours, thereby raising the efficiency of T′.

As for materials and for service, so also we must determine which T′ and R in combination result in the least cost.

In pay for services, the natural law is that an increase ought to decrease *time* in larger proportion, but in equipment it is very common to increase R unwisely and very greatly for a less decrease in T′. The same law prevails for equipment as for materials and labor. Additions to equipment should decrease, not increase, costs.

Muscular energy, whether of man or animal, is available only a few hours a day, 8, 10, 12. Uncarnate energy is available 24 hours a day. The machinery in paper mills, in glass plants, works 24 hours a day; an ocean steamer on the Pacific will throb steadily for twenty days, the big generators at the world exposition in Chicago and in St. Louis ran for six months without a stop, big pumping machinery at mines will work even longer without shutdown. There is, therefore, double and treble investment charge in working equipment only 10 or 8 hours a day.

This was bad enough, but there was a boom period after 1897 that owed its start to the Yukon gold discoveries, to a European crop failure with abundant crops here, and that was further stimulated by the sudden expenditure of one thousand million dollars in the Spanish war. America suddenly resolved to scrap all its old equipment and modernize from top to bottom. Every railroad rebuilt its main lines with new grades, easier curves, heavier rails and ties, rebuilt its bridges, stations and terminals, rebuilt or replaced its locomotives and cars, built new shops and equipped them with new tools. Every city rebuilt its business blocks and its aristocratic residence section, every street-car line was rebuilt and re-equipped. Infected by the general contagion, every industrial plant tried to increase its capacity. Paper mills doubled the width of the paper machines, thus doubling their capacity, iron mills became tonnage-mad, textile mills increased their machines beyond the world's output of textile fibres.

What are we going to do about it? There

are three correctives, and only three. Existing equipment will gradually wear out, the country will gradually grow, but during the period of readjustment those plants that are inefficient will be crowded to the wall and prematurely die. Not only are American plants subject to high equipment charges because running so few hours a day, but even for the 8 or 10 or 12 or 24-hour day, they are over-equipped and much of the machinery lies inactive.

We have again and again found that machines were not in operation over half the time of a 9-hour day. When in operation they were inefficient. It is not so long ago that a locomotive-tire lathe would be run 18, even 30 hours, to turn up a single pair of tires, work that on the same machine ought not to take over 3 hours.

The machine end-efficiency in some plants is not over 4 per cent of the guaranteed capacity. Eight hours out of 24 gives a work time-efficiency of 33 per cent, not running half the time during shop hours gives a shop time-efficiency of 50 per cent; many machines exceed the requirements of the work put to them, as when a big planer is used instead of a shaper, this form of efficiency dropping often to 70 per cent; and finally, machines are often run so slowly as to show a speed efficiency of only 3.5 per cent. When we reflect that there are other dependent sequences in the material inter-relations, in the work, and in the machine inter-relations, that there are dependent sequences between material and labor and machine, as when unnecessarily hard material lengthens the time of both man and machine, or when defective machine spoils material and wastes workers' time, or when unskilled man spoils material and injures machine—the marvel is not that industrial operations are so inefficient, but that, considering the dependent sequences, they are in each term of the sequence so high.

$$\text{Actual investment cost} = \frac{T'_{st} \qquad R_{st}}{E'_{t'} \quad E''_{t'} \quad E'''_{r} \quad E''''_{r}}$$

It is a law that it usually pays to increase quality of materials, that it usually pays to increase quality of labor, that it usually pays to increase quality of equipment, provided materials are efficiently used, labor efficiently used, equipment efficiently used. Equipment has hours about half those of labor when it ought to work as long as materials, be constantly *on the job.*

This relation of rate per hour to time is generally lost sight of. It is because it has been lost sight of that over-equipment is the rule in America. Materials, service and equipment are worked up to the general cost formula:

Total cost=Materials+Service+Investment charges.
Total cost= Q P + T W + T′ R

Usually only the greatest of industrial managers realize that Q is more important than P; that T is more important than W, that R is more important than T′, and that minimum total cost is realized when QP is minimum, TW the minimum, and T′R the minimum.

For all the operations or for any single unit

$$\text{Total actual cost} = \frac{Q_{st}\ \ P_{st}}{E_q\ \ E_p} + \frac{T_{st}\ \ W_{st}}{E_t\ \ E_w} + \frac{T'_{st}\ \ R_{st}}{E_{t'}\ \ E_r}$$

This formula shows what records are wanted, namely, the six items of standard cost and the six or more items of corresponding efficiencies. No manager, no accountant, knows where he stands unless his records show him as to every operation:

The standard quantity of material
The efficiencies of material use
The standard price of material unit
The efficiency of price

The standard quantity of time units required

The efficiencies of time

The standard rate of wages for work of the character done

The efficiency of wage rate

The standard quantity of time for equipment

The efficiencies of time use of equipment

The standard equipment rate per hour

The efficiencies of equipment use

The formula is equally applicable to a totalized operation costing one mill, as the page of a periodical, or to the operation of all the railroads of the United States as one great unit.

Records as to each detail, aggregated into records as to the whole, are one of the efficiency principles; records as to each item and every item today, records as to each and all items throughout a long period of time. He who has records of quantity and price—efficiencies of both, of every unit of material used, whether ton of rails or pint of oil; who has records as to time and wage rate for every operation, and the efficiencies; who has records as to time and investment charge per hour for every operation—he is in a position to apply the other practical principles and thus bring actual up to ideal. Records of this kind are simpler, cost less to keep up, than the usual industrial and cost records of great companies.

Cost accounting can be very simply and easily developed from the cost formula. The elaboration would carry us too far from the subject of records, reliable, immediate, adequate and permanent.

In a periodical publication, as to each page there is material, personal service, equipment charge; and if the weekly edition runs to 2,000,000 copies of 80 pages each, a saving of the one one-hundred-thousandth part of a cent in cost per page means $800 in a year, enough to leave some profit after paying the salary of a man whose sole duty might be to prevent this minute waste.

When the formula is applied to railroad operating cost it inevitably shows that E is low. We have all seen locomotive safety valves popping and black smoke issuing from stacks. There is waste of fuel, but fuel is the largest single material item in railroad operation, amounting in fact to one-third of all material expense. We have all seen railroad day laborers dawdling over their work; but common labor, notoriously of poor efficiency, is the largest service item in railroad operation, being about one-eighth of the whole. We have all seen superfluous equipment, whole roads paralleled; and even if there were not an item of duplication, is it not conceivable that with a complete understanding of the problems by people, by government and by managers, railroads might secure money at 4 per cent instead of 6 per cent, thus reducing equipment interest charges $280,000,000* a year? By the test of the cost formula we can at least analyze every item of expense, determine standards and efficiencies, and strive for waste elimination. The cost formula is one of the instruments wherewith wastes can be detected and measured; but even as Kepler proved by measurement that all planets moved in elliptical orbits, so does the proper measurement of costs show where the savings, if made, must necessarily go.

The savage destroys, the barbarian squanders, but the civilized man conserves. QP therefore measures civilization, TW measures civilization, and T'R measures civilization. There is scarcely a conceivable limit to quality, but quantity, natural resources, are limited; there is scarcely a conceivable limit

* This item was not included in the recent estimate of a preventable railway operating loss of $1,000,000 a day.

to human skill; but each individual's span of time is inexorably limited. Friction and clumsiness, duplication and waste, can be eliminated from equipment; but each machine's life is limited. As to material, shall we use radium or shall we use sulphur; as to equipment, shall we use the old round blunderbuss bullet or shall we use the slim modern pointed bullet which travels twice as fast, goes four times as far, and weighs half as much; as to equipment, shall we use subways built with 4 per cent money advanced by the city, or shall we travel on slow surface cars drawn by horses and earning 10 per cent? As to equipment, shall we use the king's couriers on the king's highway or shall we use the telephone over a 1,000-mile gap? Shall the workers idle the long days through and be content with yams and a gee string?

Civilization is high when QP is low; civilization is high in which T'R is low; but reductions in QP, reduction in T'R must be balanced by increases in TW. Records, the instruments by which these relations are discovered and determined, are not dry and monotonous; they are an inspiration and a guide.

This is the final problem:—

Shall ultimately more of us work less time each, W remaining low, or shall we all work a reasonable time and greatly increase W? Having increased our command over materials, over equipment, what shall we do with the gain? I once heard an eloquent labor-union leader expound his creed: "Eight hours for work, eight hours for play; eight hours for sleep, and eight dollars a day." Eight hours for sleep—yes; eight hours for work—why not more or less as we find pleasure and delight or aversion and pain in it? A dollar an hour! Why not what we are entitled to through elimination of material and equipment wastes? Eight hours for play? There are moments in a man's existence that count more than monotonous months—the moment when Charles the Hammer learned that the Saracens were in rout; the moment when Columbus learned that land was lifting to westward; the moment when Lister conceived of asepsis, when Pasteur conceived the germ theory. Many of the minutes of the eight hours for play can be expanded into moments worth while, through the conquest of matter and of time.

Gebraucht der Zeit, sie geht so schnell von hinnen.
Doch Ordnung lehrt Euch Zeit gewinnen!

GOETHE.

IX

THE SEVENTH PRINCIPLE: DESPATCHING

Away with all delay! Postponement always harms when all is prepared.—LUCAN.

CHAPTER IX

THE SEVENTH PRINCIPLE: DESPATCHING

THE Eskimo counts days by sleeps, counts months by moons, and counts years by long snows. He despatches himself by the seasons. The Egyptians knew that days varied in length, that the moon was no despatcher of seasons, and that the sun was no despatcher of the year, so they fell back on Sothis, the dog-star, and based their chronology on the great Sothis period of 1,461 years. Our watches and chronometers are run on sidereal time.

With our photography, with our spectroscopes, we find that in one direction the stars are widening out, that in the opposite direction they are drawing together, as our solar system swings through space; and ultimately we shall fall back on the whole universe as chief despatcher.

If we could photograph the stars at intervals of a hundred years until we had five-thousand pictures, and then run the views on a moving-picture machine, all would be rapid interlacing motion where now there seems to be immutable rest.

So much for the infinitely large; but despatching is just as much in evidence in the infinitely little.

In three weeks' time, a hen's egg, if kept warm, will change from an albuminous and fatty mass into the living chick. As boys in an English school we secured cards of silkworm eggs, hatched them by the heat of our own bodies, carefully reared the worms, watching the alternate periods of voracious activity and sloughing numbness. We watched them spin their cocoons, within which they changed to chrysalids, to emerge later as delicately beautiful moths—unless we cut short their despatching and despatched them our way with boiling water. All growth and decay are manifestations of the principle of despatching. The emanations of radium, that marvelous element, have almost revealed to us the ultimate constitution of matter, and we now know that every atom is in a ferment of activity, as orderly as and perhaps far more complicated than a solar system.

The Egyptians had wrested from the stars their time secrets and arranged accordingly their dynasties, also their great Sothis month once in 120 years, a leap-year month; but they did not know that ophthalmia is carried by filthy flies and that it grows in each case as regularly as solar cycles. So from the prehistoric paleolithic age to the last decade, Egyptian babies have gone blind with preventable blindness.

It is apparently easier to grasp and acquiesce in the large than in the small, easier to rush to certain death in a battle than to endure a cinder in the eye, but he that ruleth his spirit is better than he that taketh a city.

At every hotel there are racks filled with railroad time-tables. These are issued by the ton every month and show to the minute the exact time during the future weeks every passenger train in the United States is scheduled to reach every station. These are the popular, abridged time-tables. For the employees there are time-tables much more carefully compiled, covering also the freight trains and giving all the rules of operation.

In railroad operation marvelous despatching has been attained, more accurate than the seasons, more reliable than the tides, almost equal to the star time on which it is based. Lines of track nearly a thousand miles long stretch between New York and Chicago. Every switch, every grade, every curve, is known; the line is studded with signal towers and punctuated with stations. In the round house is a locomotive with boiler capable of carrying 225-pounds steam pressure, which through the cylinders and pistons pushes on the wheels with rims polished like glass. The rims transmit 400 horse power through a quarter-inch square of contact with a glass-smooth rail. With one load of coal, drinking from tanks as it runs, the locomotive is able to speed 140 miles at the rate of 60 miles an hour. The seventy-two to eighty-four wheel axles under the train must each run true in its box, everything in track and equipment, in men, and above all in spirit, must be in perfect order all the time. On the basis of these conditions a schedule is made out, a schedule of running time, with due allowance for grades and curves and stations, an 18-hour schedule from New York to Chicago. The train is then despatched.

The despatchers issue orders to the conductor and to the block-signal men, thus controlling the train from both ends. While under the orders of the conductor, while physically under the control of the engineer, it is the despatcher who from start to finish holds it in the hollow of his hand. This is the highest degree of despatching that has been reached in America. It is perfect in its way, and all Americans are justly proud of it, although as a marvel of human skill and despatching excellence it is not to be compared with the despatching of the Franco-German war by von Moltke, when over a million men were despatched, and empire-making and destroying battles were fought at a predetermined time and place, with predetermined victory for the great despatcher, predetermined defeat for his less skilled opponent. The big task was carried through because of perfect preparation. The German army had no track, no perfect locomotives, no built and tested signal towers, but it had a perfectly working organization that had not omitted to give attention to every little detail.

In America we fail in details. We step from the 18-hour train and we enter a railroad shop. We ask, "Do you despatch your work here?"—

"No, this is a repair shop. We rarely do the same thing twice. Despatching is all very well for a daily train running every day in the year, but it would never apply in a repair shop." The official in charge with ill-disguised skepticism enquires whether the questioner is a railroad man, whether he understands the peculiarities of railroad operation. We say nothing, but we wonder whether a surgeon without railroad experience could take out a railroad man's appendix. Has the official fully grasped the fact that as to most of life facts, as to the fundamentals of conception, gestation, birth, nutrition, growth, development, he is one with his cousins, the other mammals; that as to most of the balance he is one with his human brothers, and that even if he had the special talent of a Paderewski, he could not play without hands, nor compose if he had the toothache, nor appear in public barefoot? We wonder that the official does not see that the laws of order, of sequence, of rhythm, of balance, and several others are superior to all minor peculiarities. Once when I was suddenly stricken in a railroad shop and was taken, distorted with pain, in an ambulance in my grimy, disheveled clothes to a railroad hospital, they thought I was a tramp who had fallen off a brake beam, but neither I nor they were worried about my official standing as they tried to mitigate the sufferings of a sick man.

To return, not to this railroad shop, but to the other where the doubting official is standing, I suddenly see a man shaping a small piece of steel about the size of a visiting card. I do not know what it is for, but in thirty seconds I notice that the moving tool is cutting air three inches and cutting metal one inch; efficiency of stroke is therefore about 30 per cent, with due allowance for clearance at each end. I ask the man what kind of tool steel he is using, and he answers "blue chip," but this means nothing to him, as instead of making blue chips his metal chips are dull gray. His cutting speed is about one-third of what it ought to be, therefore efficiency of speed is 33 per cent. His tool is diamond-pointed and his feed is 1/64 inch. He should have used a round-nosed tool and the feed should have been 1/16 inch, so that the efficiency of feed is 25 per cent. His depth of cut is as thin as he can make it, so he takes three so-called roughing cuts and then a finishing cut when one deep roughing cut and a broad, scraping, finishing cut would have answered. His efficiency on depth of cut is not over 50 per cent. The time efficiency of the whole job is therefore $30 \times 33 \times 25 \times 50 = 1.25$ per cent—but a little over one per cent. These are the visible inefficiencies. I surmise a number of others that I do not see. I suspect that perhaps the piece was not needed at all, that some worker or foreman is doing some unauthorized experimental work; I suspect that the piece needs no such finish. I have too often seen infinitesimal cuts, followed by file and emery cloth, put on a piece that is then flung down on the rough floor and badly dented with no apparent interference with its usefulness. I have seen a scraping tool put on locomotive tires, taking off tissue-paper-thin scrapings, when everybody who thinks a minute knows that car axles (a much more important surface) are often given a rolling finish, and that locomotive tires, however rough, would roll smooth before the engine had rolled out of the shop. I have seen a railroad shop man put hours of work and use \$600 of material on a replacement when a \$27 repair would have abundantly answered the purpose, a man not heeding the Scripture injunction not to put a patch of new cloth on an old garment lest the garment be weaker than before. Why continue these painful examples?

The railroad that despatches its crack trains with 99 per cent of time accuracy has either no despatch system or a very crude one for work, either big or small, through its shops; therefore in some cases it fails to realize an efficiency of even 1 per cent, and on the big average of all shop work fails to realize either a time or cost efficiency of more than 40 per cent. Our universe would not last very long if only the stars were despatched. It is the despatching of our daily meals, the despatching work of ferments, of bacteria, of protozoa, of molecules and of atoms, that counts.

A firm in Chicago has taken a million-dollar contract to bring out a new edition of a great encyclopedia. All the work is despatched. Conditions were standardized, operations were standardized, each volume, each page, each column, each line, each letter is despatched, even as the proper lubrication of each car axle is part of the proper despatching of the 18-hour train.

Many years ago on the Yukon I said to a river-steamer owner: "I suppose you much prefer passengers to freight. If you run on a sand bar, the passengers can get off and help you to put the steamer afloat." He told me plainly, forcibly and picturesquely that I did not know what I was talking about. If a passenger boat stuck on a bar, the passengers did nothing but grumble and cause trouble, and the only way they lightened the load was by eating more of the food, but a load of freight would not complain if it not only ran on a sand bar but in addition was caught in the ice and remained all winter.

Railroad despatching as to passenger trains is of a very high order of excellence; as to freight forwarding it is gradually emerging from the dark ages, perishable freight going forwards almost with passenger regularity; wrecks, slides, snow are taken care of with a despatch of the highest order of excellence; railroads are even built on schedule time; but considering the expenditures that are not despatched and those that are inefficiently despatched, the general despatching efficiency, even of railroads, is not over 40 per cent, yet there are few activities that do as well as railroads. The reasons the despatching efficiency is so low are many, but chief among them are lack of proper type of organization, and failure to apply principles as distinguished from empirical makeshifts.

Nevertheless, there are very few other activities scheduled as far in advance and as accurately as train despatching. Newspaper offices furnish wonderful examples of scheduled work, so also do theatres, and perhaps the most wonderful of all are the weather reports, gathered over an area of four million square miles, compiled, digested and distributed within a few hours of receipt. But most of the industrial plants of the world are still in the stage of civilization of which as to transportation the old freight wagons and prairie schooners across the plains were types. They started when they got ready, they arrived some time, and nobody knew where they were nor what route they were taking in between.

There is one collection of industrial shops in the United States in which schedules and despatching have been so perfected that the work is planned ahead three months and the particular job that each man is to do at 4 o'clock or any other hour for any day is known. Planning long in advance is convenient, but is not an essential part of scientific despatching. A barber shop is scientifically despatched from minute to minute, and a customer entering can figure very closely on the time that he will be able to leave.

Railroad despatching remains, however, the most extended and striking example of advance planning and daily realization. It seemed quite obvious, therefore, to extend these railroad principles of despatching to the operations in a railroad shop. Railroad officials fully understood what despatching meant, were accustomed to work under its rules. It proved, nevertheless, a very difficult task. In the running of trains a very great deal precedes despatching. There is a carefully worked out schedule which has been more or less tried out for months. How many of these conditions are present in the industrial shop? Where are the standardized conditions, where are the standardized operations? Where the discipline, the maintenance, the schedules?

Railroad shops as to despatching are in the same backward condition as most industrial shops. Therefore it was found that despatching by itself could not be immediately applied, that many other preparations were necessary, that if the application of other principles was worked out, despatching would become easy.

The application of principles will change a mob into an army, whether in field or shop. The frenzy of a mob shows itself in a lynching, but the courage of an army ought to be highest in defeat. When men, foremen, officials, equipment, supplies, had been subjected for a year to the operation of principles, a beginning was made of despatching locomotive repairs. The subject was attacked from both ends at once. Locomotives were worth a great deal to the road, a day's service being estimated at $35; therefore the first plan was to despatch the repairs as a whole, locomotives to be returned to service in 12 days, 18 days, 24 days, according to the class of repair. The second plan, worked in with this, was to despatch each separate item of work and to pick out those items which, taken at the proper time, in the proper order, and in the proper sequence, would result in completing a locomotive in the shortest time.

It is interesting to note in the matter of repairs the great superiority of marine-repair despatching over locomotive-repair despatching. A big vessel will be put in a dry dock, at $5,000 a day charge perhaps, and be completely scraped, repainted, new propeller and rudder fitted, new plates inserted, in perhaps three days. Complete circulating pumps, from drawing to installation, will be completed in three days. Where individual operations are summed up, many of which can go on concurrently, it is hard to defend a longer time than 72 hours for most locomotive repairs.

It is also interesting to note that in the sister branch of railroad maintenance, namely, track repairs, stupendous tasks of snow and landslide removals, bridge rebuilding, etc., are commonly accomplished in hours rather than in days or weeks.

It is evident that brain must count for more than muscle in attempting to apply despatching to locomotive repairs. We had to know that men would be available, therefore discipline and the fair deal both had to be strengthened; ideals of order, of promptness, of economy had to be instilled; common sense had to be applied; records had to be started, but other principles also had to be applied. Conditions of all kinds had to be standardized, operations had to be standardized, schedules had to be made out, and definite instructions had to be issued. It is really very much easier to apply a few principles than to remedy several million defects. The easiest way is to forget these defects in the past, ignore them for the present, but constantly obviate them for the future.

A new plan was gradually substituted for the old plan. In the railroad shop major schedules were worked out and put into effect by despatching; minor and subsidiary schedules were made out for each job, each man, and each machine, the lesser jobs fitting like parts of a puzzle into the larger schedules, and on the basis of schedules, however often they were changed, men, machines and jobs were despatched. All work, instead of passing directly from foreman to worker or to gang, passed through our despatch board. Practice was perfectly elastic, but procedure was not. Schedules could be changed on a moment's notice and also the sequence of despatching, but not the fact of despatching. The particular shape and size and location of despatch board is unimportant, the essential being that it is suited to the work. Whether the despatch board is covered with parti-colored strings, or made up of hooks, clips, or pockets to receive cards, is also unimportant in principle, but not in practice, since a method under which many of your despatching cards blow out of the window soon becomes inoperative.

The name *despatching* was adopted from train despatching, and train operation organization was adapted. The foreman corresponded to the engineer, a new official was created corresponding to the despatcher, a messenger and telephone service kept the despatcher's office in touch with the work. Despatching records, however, were adapted from bank practice. The receiving teller takes in money, he enters the amount in the depositor's time book, he credits the bank's cash book with the amount received, but he also credits the ledger account of the depositor. When the depositor draws a check it is presented to the paying teller who hands out the cash, charges the cash account, charges the depositor's account. At the end of any day the total cash in hand must correspond with the sum of the balances in all the accounts. Similarly the despatching board, like the cash book, is filled with prospective work. As fast as any item is performed it is charged to the order. The operator is charged with the pay he draws and credited with the work he performs.

There must be at the day's or week's or month's end a perfect balance between all work credited to operators and charged to orders, also a perfect balance between wages and other accounts charged and totals credited to work in progress and delivered since last balance. The records are immediate, absolutely accurate, and wholly adequate.

In practice it has proved more important to despatch unstandardized work than to standardize undespatched work, even as on railroads it is more important to despatch trains even if there is no adherence to schedule than it is to run trains on time without despatching.

Despatching, like other principles, is a subdivision of the science of management, a part of planning; but while visible to the eye as a distinct pattern, it ought, like inlaid work, to be intactile. If we are well nothing is more beautifully despatched than the food we eat, from plate to building up of depleted hidden tissue. We are conscious only of the pleasure of the first taste, not conscious of the admirably regular way by which each molecule is ultimately despatched to its destination.

X

THE EIGHTH PRINCIPLE: STANDARDS AND SCHEDULES

The bird is nearly a thousand times as heavy as the air its bulk displaces, but how inimitable is the work —for the way of a bird in the air remains as wonderful to us as it was to Solomon. As a child I watched a hawk soaring far up in the blue sky and sailing for a long time without any motion of its wings as though it needed no work to sustain it, but it was kept there by some miracle. I saw it sweep in a few seconds in its leisurely flight over a distance that to me was encumbered with every sort of obstacle which did not exist for it. The wall over which I had climbed, the ravine I had crossed, the patch of undergrowth through which I had pushed, all these were nothing to the bird, and while the road had only taken me in one direction, the bird's highway led everywhere and opened into every nook and corner. How wonderfully easy was its flight. There was not a flutter of its pinions as it swept over the fields in a motion that seemed as effortless as that of its shadow!—LANGLEY.

A perfect and just measure shalt thou have; that thy days may be lengthened in the land which the Lord thy God giveth thee.—*Deuteronomy*, 25, 15.

CHAPTER X

THE EIGHTH PRINCIPLE: STANDARDS AND SCHEDULES

HUMMING birds winter in Central America and nest in summer in Alaska, yet bring up families as beautiful, as courageous and as achieving as themselves. The stormy petrel flies four hundred miles through the fog and strikes its burrow exactly, storks marked in Norway have been caught in South Africa, curlew and plover are supposed to fly at the rate of four miles a minute.

The barn-yard fowl, if frightened, runs and flutters over a low fence, and panting with exhaustion is soon run down. The rooster uses his wings to flap when he crows, the hen uses hers to brood her chicks, their ancestors having forgotten that they were birds and that the limitless air was their inheritance.

"Whoever heard of a woman tiring when she was having a good time, even if she had danced all night?" said Nietzsche, and the police in San Francisco on March 20, 1910, on advice of doctors present, stopped a dance after six of the contestants had been dancing 15 hours and 6 minutes.

Prof. William James pointed out and insisted on the second wind, the ability that comes after first fatigue, after the barn-yard flutter, to endure and achieve, to fly!

Standards and Schedules! These are of two kinds, the physical and chemical standards discovered and established in the last century, standards and schedules as exact as mathematics, and those other schedules resting on standards whose upper limit we do not yet know. We have our five senses. We can taste or smell an infinitesimal taint in food, we can smell the millionth part of a grain of musk, we can discern by touch the ten-thousandth part of an inch, a man heard 2,390 miles away the boom of the explosion of Krakatoa, we see billions and billions of miles distant a new star bursting into brilliance; but there is a region not ten miles away about which we know less than we know of the nebulæ, because we cannot reach it with our senses, nor yet with our physics and mathematics—a region ten miles or less straight down under foot.

By bringing into play our instruments, our bolometers which measure the millionth of a degree of heat, our ultra-microscope which almost enables us to see the atoms, one one-millionth of a second measured on the tracing of a tuning fork's vibrations—by the refinements of physics and chemistry we can peer into the true inwardness of material things; so we use stop watches for time and motion studies of our machines; but when we wish to schedule work foı sentient beings, then our mathematics fail and we fall back on experiments inspired by faith. Four miles a minute the flight of a little bird, 99 per cent and more the efficiency of the firefly's flight, the sixth sense of the blinded bat, the sudden stop of the grizzly bear from full trot in darkest night when he was within a foot of the finest flower wire leading to a flash-light camera!

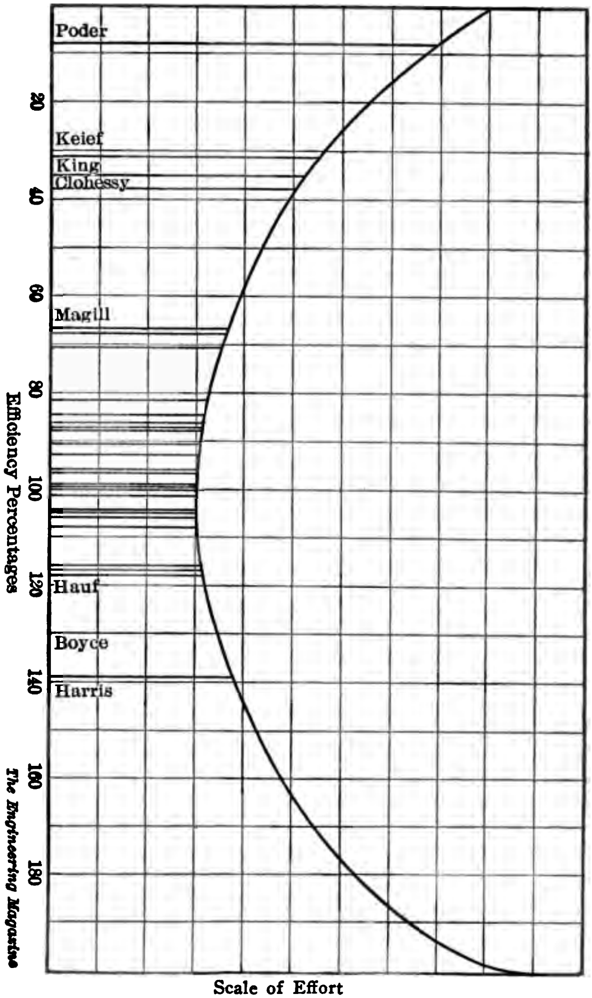
All around us, everywhere nature has been showing us that increased result comes from lessened effort, not from greater effort, but we have been too stupid to understand. Because it takes one pound of coal to produce one horse power, and two pounds of coal to produce two horse power, because it is harder to jump over a fence four feet high than over a fence two feet high, because it is more difficult to jump over a fence five feet high, we have non-reasoned back from results to effort, and concluded that effort should be gauged by result which is in accord with one set of experiences but wholly contrary to the larger experience. Any specific kind of effort, measured by results, falls from a maximum to a minimum and then rises again to another maximum, so that there is only one point where maximum result is attained for minimum effort, a point properly scheduled at 100 per cent.

As to specific result it may be attained in many ways. Tame geese in Germany are slowly driven to market in September, waddling a few miles each day. They are prepared for the trip by walking through soft, warm tar and then through fine gravel and sand, so that, thus shod, their feet may stand the weary march. Wild geese fly from Golofnin Bay, Alaska, to the tropics in less time than the tame geese waddle a hundred miles. The wild goose's distance and time schedule would be ridiculous for the tame goose, the latter's schedule an absurdity not less cruel for the wild geese.

As to the variation in effort for similar conditions, we have but to remember that while it is pleasant to spend from six to twelve hours in bed, it is an affliction to spend all one's time in bed, a greater affliction than to have no bed and to snatch rest as one can on a long tramp or journey, for men can sleep even when walking. It is easy to walk three or four miles an hour; it is intensely wearying to stand waiting or to walk two miles an hour, when shopping with one's wife—more wearying than the five-mile an hour trot of the Yukon winter trail. It is easy to ride a bicycle 10 to 15 miles an hour, it is desperately hard to ride 1 mile an hour or 20 miles an hour, and either endeavor will send the rider exhausted to bed. How much more exhausting it is to breathe either fast or slow than to breathe naturally, the latter being absolutely effortless and kept up from birth to death, waking or sleeping. Natural breathing, natural heart beats, natural temperature, are 100 per cent efficiency.

This law of the reduction of effort for greater results crops up in the most unexpected places, so that engineers have evolved the definite critical speed, the speed of maximum result for relatively least expenditure.

In fast steamers resistance does not increase with the cube of the speed, but there are certain higher critical speeds at which resistance is



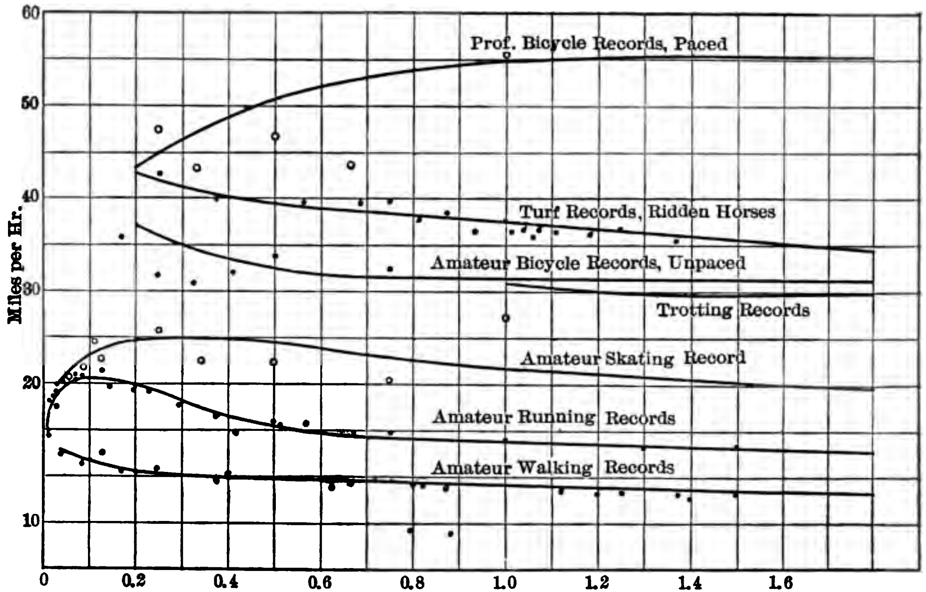
TYPICAL MAN-EFFICIENCY DIAGRAM

less. Nearly 100 years ago in England a man running express-passenger canal boats had them towed by galloping horses at a speed of nearly 14 miles an hour, claiming this was easier than a slower speed. He was ridiculed by scientists who opposed the law of cubic increase of resistance. A bet was made, dynamometers attached, and up to 8 miles the law held good; but above 8 miles the canal boat began to climb out of the water, so that at 14 miles the actual resistance was small. This was the origin of the hydroplane boat. A wise Kansas mare hitched to a plow, pulling heavily, would look back, take in the situation, and increase her speed. The plow immediately pulled easier because the greater speed flung the clinging earth free of the mold board, thus greatly lessening friction.

Time and motion studies having been made as to all the work of a gang of men, both conditions and operations were standardized and an efficiency reward was offered. The results are shown in the diagram opposite. Nearly all the men are grouped between 80 per cent and 120 per cent, with the greatest density around 120 per cent—the region of least effort. The hardest worked man both physically per unit of time and physically per unit of result, was Poder, with an efficiency of 7.8 per cent. He was more exhausted at the month's end than Harris, who attained 139.2 per cent; Keief, King, and Clohessy were more tired at the day's end than Boyce and Hauf; Magill was as tired as Hauf.

A casual observation of the passengers leaving the Atlantic Highland boats at the Rector Street pier in New York on a Monday morning in summer, shows conclusively that in the crowd, some (a very few) travel over the long gallery from boat to street at the rate of 6 miles an hour; others, quite a bunch, at the rate of 4 miles; but the great body travels at the rate of 3 miles, and there are stragglers, mothers with little children, old ladies of social weight, also lingering lovers, who travel at rates shrinking to 2 miles an hour. The able-bodied, in so far as not hindered, have an average rate of 4 miles; and from these observations of voluntary effort, we can well establish a walking standard of 4 miles an hour with disapprobation if the rate falls below 3 miles, with special reward to those who reach and pass the 4-mile mark. Had we diagrammed these walkers on the pier, they would have given us a picture similar to the machine-shop curve of Poder to Harris. Both diagram and description show that the increase of effort between 100 per cent and 140 per cent efficiency is very slight—only 25 per cent, quite within the limit of normal variation above the rational average; and it also shows how it is possible for a good man to deliver nearly twenty times as much as the incompetent man, four times as much as the laggards, twice as much as the haphazard workers. Poder, Keief, King and Clohessy could never become Hauf, Boyce, and Harris. Piece rates based on the performance of Harris would be as ridiculous for Poder as wild-geese schedules imposed on tame geese fattening for Michaelmas; but, without injustice to Keief, King, and Clohessy, the natural Haufs, Boyces, and the Harris clan can be selected for their natural work and be correspondingly rewarded.

There are places where Poder and Clohessy would fit, even as the tame goose, plucked for its feathers and prepared for the feast, shows 100 per cent efficiency, and the thin, stringy wild goose is far below par. The schedule must fit the man and the man the schedule; there is no such thing as a definite universal schedule.



The Engineering Magazine

DIAGRAM SHOWING SPEEDS IN MILES PER HOUR FOR BEST ATHLETIC RECORDS. SHORT DISTANCES

At best there is a broad schedule band (in the diagram, the region between 80 per cent and 120 per cent) and the records will show clearly whether the men have been selected to fit the schedule and whether the schedule fits the man. Irrespective of any current wage rate, a shop cannot be filled with the Hauf to Harris thoroughbreds for the wages that will attract the Poders and Clohessys.

If all conditions were absolutely standardized, if all operations were also perfectly standardized, piece rates might apply with reasonable equity and fairness to the tame geese traveling the same road in the same weather with the same tar-sand shoes; but what about the wild geese far overhead? They must have schedules based on other standards.

The physiological objection to piece rates is that they stimulate strenuousness, increase of effort, when what we want is a betterment of conditions so as to achieve greater result with less effort.

In the diagrams on pages 270 and 272 the speeds per hour for the best athletic records from start up to 100 miles show the time relations between different methods for the same distance. The results are tabulated as follows:

TABLE OF ATHLETIC RECORDS

	One Mile		One Hundred Miles		
	Actual speed	Relative speed	Actual speed	Relative speed	Relative to 1 mile
Amateur walking..	9.2	100	4.8	100	52
Amateur running..	14.	152	5.6	117	40
Amateur skating..	21.8	237	14.	292	64
Amateur bicycle unpaced	31.4	341	20.2	421	64
Professional bicycle paced	55.3	601	35.5	740	64

It is known that each of these men put forth his best efforts, and assuming the men to be equal in strength, endurance, skill, we become certain that the mere addition of skates to the shoes increased the speed for the same effort 2.37 times at one mile and 2.92 times at 100 miles; that the substitution of a bicycle for skates increases the speed 3.4 times at one mile, 4.2 times at 100 miles; and that the addition of a helping pacer, who in no way touches the rider, merely shielding him from the wind, increases the speed above walking six-fold at one mile, 7.4 times at 100 miles. All these records are of abnormal, excessive, and extreme speeds, but who can doubt that the relation would remain the same if they were halved, thus brought down to high normal—4.6 miles for walking, 28 miles for paced bicycle?

The time may come when aeroplanes rising on the wind as do the birds will glide on upward currents, as also do the birds, at a rate of two miles a minute for a thousand miles, or twenty-five times as fast as the walker, yet exert no muscular effort, using delicate instruments to feel the wind, and intelligence to guide the flyer.

Other facts appear from the table and dia-

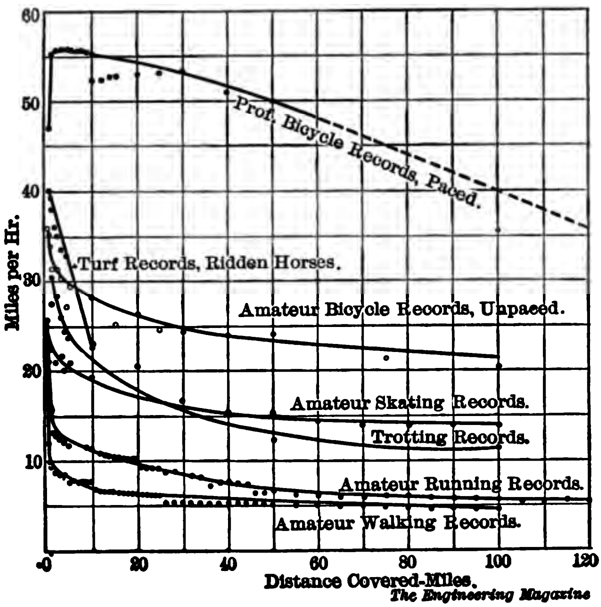


DIAGRAM SHOWING SPEEDS IN MILES PER HOUR FOR BEST ATHLETIC RECORDS. LONG DISTANCES. FOR SHORT DISTANCES SEE PAGE 270.

gram. For the 100-mile stretch compared to the one-mile stretch, both bicycle and skating fall to only 64 per cent of the speed, but walking and running collapse respectively to 52 and to 40 per cent, so the man-used and man-driven tools not only vastly increase the speed, but maintain it at a far higher proportion. At one mile the paced bicycle rider is only six times as fast as the walker, at 100 miles he is nearly seven and a half times as fast.

It also appears that the trotting horse, who begins faster than the skater, is distanced by him at 24 miles, and after that steadily falls behind. The horse does not have the man's courage. The man helped only by his bicycle is throughout faster than the trotter, faster than the running horse after the third mile.

For physical, for chemical, and for electrical relations we can set absolute standards:

$$\text{1 horse power} = \begin{cases} \text{746 watts.} \\ \text{33,000 foot-pounds per minute} \\ \text{2,545 heat units per hour} \\ \text{0.175 pounds carbon oxidized per hour} \\ \text{2.64 lb. of water evaporated per hour} \end{cases}$$

Practical standards are very different—one pound of coal in steam engines per horse-power hour, 10 pounds of water evaporated per pound of coal instead of 15!

For physical standards we can measure the extent of the shortcomings and diligently strive to lessen the losses; but in making standards and schedules for man we must first classify our men, and then we must so equip them that they can as easily do six times, seven times—yes, perhaps one hundred times as much.

Walking 9.2 miles an hour is as to normal walking 200 per cent efficient, not a normal standard for any regular work, but compared to the effortless glide of the aeroplane it is only 10 per cent efficient.

To establish rational work standards for men requires indeed motion and time studies of all operations, but it requires in addition all the skill of the planning manager, all the skill of the physician, of the humanitarian, of the physiologist, of the psychologist; it requires infinite knowledge, directed, guided and restrained by hope, faith and compassion.

The promise already partly fulfilled and clearly held out as to the future is that greater and greater results shall follow constantly diminishing effort.

XI

THE NINTH PRINCIPLE: STANDARDIZED CONDITIONS

Darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters. And God said, Let there be light: and there was light. And . . . it was good: and God divided the light from the darkness.

Maximum vitality and maximum efficiency are tied up with each other. What makes for one makes for both. To learn how to attain one is to learn how to attain the other.—DR. LUTHER GULICK.

CHAPTER XI

THE NINTH PRINCIPLE: STANDARDIZED CONDITIONS

"HITCH YOUR WAGON TO A STAR"

THE larva, grub, or worm crawls from the egg and its existence is governed by the accident of its birth site and surroundings. Usually it stays where it was hatched, eats and grows, and it arouses neither enthusiasm by the interest of its life nor admiration for its beauty. It is elementally dull and prosaic, for it has neither standardized itself to command conditions nor standardized conditions to suit itself. At last, having reached the limit of its growth, it passes into the pupa or chrysalid state of coma, and emerges, physically, spiritually and mentally a different individual.

Who would recognize in the purple emperor butterfly the caterpillar of its previous existence? The butterfly is as beautiful as the worm was repulsive, as mobile as the worm was slow, a creature of the sunlight and sky instead of the shadows and of the earth.

The water-beetle is the lord of the elements. It runs on land with speed, under the water it is one of the quickest and most graceful of swimmers, and through the air it is the fastest of flyers; it seeks its food in the water, it emerges at dusk, and after dark flies toward the moon, or to its destruction in some electric light. More perfectly than any other creature it has standardized itself to play with and command all the elements but fire.

The spider, not so standardized to earth, water, and air, as the water-beetle, has not to the same degree conquered the elements. The beetle swims, runs, flies without effort because its ancestors had aspirations and early achieved victory. The spider works consciously, much as men might work. She drops from a height, not with wings to sustain her, but holding on to a thread made for the occasion, strong and elastic. In mid-fall she can stop, the factor of safety being nothing, yet I have never seen the silken thread break. She can regain, if she wishes, her exact starting point, or, reaching the ground, can cut loose and run. The spider would disdain as clumsy a suspension bridge, for she constructs a canopy whose outlying guy stays have, in proportion to her length, greater reach than the span of the Brooklyn Bridge, whose strength in proportion to construction is greater than that of the best steel wire. The balloon spider, if at all interested in human balloons, must despise them! She, on a calm, sun-lit summer day, will spin out a filament which, warmed by the sun rises straight into the air. Whether the spider, like the soaring birds, first locates an upward air current and then spins her thread, or starts an upward air current though the warmed molecules adhering to the thread I do not know; but in any case the filament rises, rises, until the spider knows it will lift her, and then loosening hold, she soars skyward to be swept by some upper air drift miles away in a few hours, her relatively great weight carried upward and sustained by a thread weighing not the hundredth part of what she weighs. Standardized conditions there must be of almost inconceivably delicate adjustment, of sunlight, of calm, of length and make of thread.

Both soaring birds and balloon spiders and many floating seeds and spores use directly the heat of the sun to sustain them. What bird ever soared at night or upward through a fog?

There are other insects that have solved deeper mysteries than either the water-beetle or the spider. Men can run on the earth, not as well as the beetle; they can swim, not as well as the beetle; they can glide through the air, not as well as the beetle; they can climb down or up ropes, not as readily as the spider; they can stretch suspension bridges not comparable to the canopy of the spider; they can soar in balloons, not as safely or as conveniently as the balloon spider—for these are all mechanical operations. But the firefly produces light by a chemistry of whose laws and operations we have no grasp. The firefly has not standardized itself to the daylight. It wanted light when it was night, not general, diffused and impersonal light, so it creates in the velvet darkness the momentary and intermittent personal flash, for the moment making itself the centre of the visible universe. It not only refused to acquiesce in the standard light of day and darkness of night, but it remade the conditions of the universe to suit itself.

This is not all of the marvel. The firefly and the human both have eyes, and in these eyes are minute nerves which make us aware of light and interpret to us the shape and color and distance of all the outside world.

There are, therefore, two distinct methods of standardizing conditions—to standardize ourselves so as to command the unalterable extraneous facts, earth, water, air, gravity, wave vibrations; to standardize the outside facts so that our personality becomes the pivot on which all else turns. With the living example of the beetle who commands earth, water and air, with the example of the firefly, which, without effort makes light where there was none, with the lesson of our own eyes which have given us a beginning of command of infinite space and time, shall we fear to attempt standardizations of conditions now but dimly conceivable?

The easiest way for any individual to live his own life in fullest measure is either to standardize himself to suit the environment or to standardize the environment to suit himself. The horse and other animals stay where they are in winter and grow thick and long fur to meet the rigors of the climate. The bird of passage changes itself not at all, but suits the climate to its taste by picking out the one it wants and going to it. Either way is an easy way, but man, the youngest of nature's brood, has attempted to satisfy great wants without standardizing either himself or the environment.

To build the Great Pyramid absorbed the lives of 100,000 men for 20 years, and it is the greatest monument of inefficiency the world bears because conditions of building were not standardized; yet the Egyptian builders had eyes which reached out and recognized, through billions of miles of empty intervening space, the groupings of the stars. Without sweat on our brows, nor callosities on our hands, supplementing the same human eyes with telescope, with spectroscope and with camera, we tear the distant stars apart, we dissect them, we drag them into light out of the depth of darkness, we assist at their birth, trace their lives and predict their extinction. Thus, at last has man begun to make himself infinite and the universe small.

In the building of the pyramids, of the Parthenon, and of St. Peters, man followed a lawless fancy and not an efficiency need, or the work and time and expense would not have been so lavish for so small return. Man has, in fact, until very recently remained in the larval state. He put on clothes to keep out the bitter cold, but little further advanced than the Tierra del Fuegan who shifts a patch of fur between his naked body and the wind. He huddled over a fitful fire to banish the cold, and these two feeble steps upward in the adjustment of self and the conquest of environment were almost all. At best, until recently he has tried to imitate the beetle and the spider rather than imitate the firefly. He invented shoes that he might travel along the rough trails, he invented skates that he might glide over the ice, he invented boats and sails that water and air might carry him. But at last he has awakened.

Roads were built that a barefooted multitude might travel in slow comfort. The distance from Paris to Bordeaux is 323 miles, and this the fastest walker once covered in 114 hours and 42 minutes, or at the rate of 2.8 miles an hour. Even after a standardized path had been created it took many generations before a bright mind evolved the idea that a revolving wheel would be more adapted to the road than alternating footsteps, so we had the roller, the cart, the wheelbarrow, and at last the bicycle was perfected; but even this last step took three generations. In the bicycle man still used the alternating swing of the legs, but he propelled himself nearly seven times as fast, so that Huret made the 323 miles in 16 hours and 45 minutes, at the rate of 19.8 miles an hour. But why should a man use his own efforts? He cannot trill his legs as he can his fingers, and even if he could, the leg cannot push much harder than 200 pounds. He had already used steam to propel locomotives on their more minutely standardized road, so he finally attached an explosive reciprocating engine to his road vehicle, an engine capable of making 1,200 strokes a minute for each of four, eight, fourteen, cylinders, as compared to the 140 strokes of each of two legs; an engine capable of kicking 100 pounds per square inch for as many inches as the piston surface has area, as against the man's total power of push of less than 200 pounds. So that in his cushioned seat, with mere pressure of hand or foot, Gabriel, in the race from Paris to Madrid, made Bordeaux in 5 hours 13 minutes, or at the rate of 62.5 miles an hour. In this race the automobiles were confined to the road, the road was narrow, the people many, so a number were killed. Why therefore be bound by the limitations of a road? Captain Bellinger, on an aeroplane, makes the same trip in 5 hours 21 minutes, actual flying time, at a speed of 60.35 per hour. Flying speed will soon be 80 miles an hour and already the French mathematicians are pointing out that many of the present difficulties of flight will vanish at the higher speed.

In the meantime, however, because conditions have been standardized, instead of building pyramids nearly 500 feet high in 20 years, our skyscrapers go up 600, 700, 800 feet in 10 months; we tunnel through mountains and, laughing at wind and wave, we send a floating palace, larger than St. Peters, through the ocean from continent to continent at the rate of nearly 29 miles an hour.

The principles under which the methods and practices of efficiency are grouped have been compared to the skeleton framework of a dome. The ribs of the dome are the principles, but the first layer can be started with one part of each rib in place, and with filling of various devices to complete the circle. As layers are added the ribs rise until they come closer together and at last coalesce. Some ribs may be carried to the top, others may stop part way up, their burden carried by others. In this series of essays each of the earlier ribs has been separately carried to the top, so that now there is less space for the later principles, much of their duty having been transferred to the principles already in place. To maintain reliable, immediate and adequate records we must have standardized conditions; to put in schedules we must have standardized conditions; so the standardizing of conditions should precede schedules. But unless we have already adopted ideal schedules, how do we know what conditions, and the extent to which they must be standardized? Also, unless we have ideals as to standards, how can we create a high schedule?

It is perhaps because schedules and conditions react so on each other that progress is so disappointingly slow. We make a mean little schedule and meanly standardize conditions to suit. Francis Galton points out that the Basutos in Africa have the greatest difficulty in finding oxen fit for the forespan. The ox who stays in the centre of the herd is not the one struck down by the lion; so through many generations the independent bulls and cows have been eliminated until it requires careful watching to select, and careful training to develop, a calf capable of walking ahead and leading the others.

In human affairs, however, when we are on any schedule there are some who are not afraid to beat it, although the herd puts up a clamor that the effort is killing and should be prevented by combination. Perhaps the effort is temporarily killing; but ultimately some progressive soul aspires to a yet better schedule, and instead of foolishly trying to beat the record under the old conditions, restandardizes the conditions and thus makes an advanced schedule easier than the former schedule.

Records are again broken by effort, far less at its maximum than on the old schedule, but nevertheless discountenanced by the conservatives, until conditions are again restandardized and effort is still further diminished. Who has the harder time, the runner who precedes the cavalcade of an Oriental magnate, or the engineer of our fastest trains? Who puts forth the greater effort, the peon who twelve hours a day carries load after load of ore in sacks on his back up a notched pole out of a deep Mexican mine, or the fireman who for two hours and a half between New York and Albany, calling it a day's work, shovels coal for the fastest train?

In the locomotive runs across Arizona where oil burners are used, even the fireman's work, usually so hard, has been converted into watching the water glass, watching the smoke, and with his fingers turning on and off water and oil supply.

The grub acquiesces in the obvious; and until the last century, all but very few men acquiesced in the obvious. By force of ancestral habit this acquiescence is still the curse of most of us. Our ideals, our schedules, have been and are too low instead of too high. The 18-hour trains between the two largest American cities are on the highest regular long-distance schedules thus far attained; but on an open speedway not comparable to the steel track in smoothness, an automobile with its little engine, and one man guiding, ran faster and longer, so that in comparison 18 hours seems slow; and, quite surely somewhere, some time—perhaps in China or Africa—Brennan's gyroscope car on a monorail, indifferent to both grades and curves, shortening distances one-fifth, will do in 8 hours what now takes 18.

In planning for standardized conditions, it is difficult not to skip the present and plan for the future; but even in the greatest American plants, the conditions imposed by an ignorant and inefficient past are accepted, schedules are toned down, and painful effort crowds out intelligent control. In one large plant where the heaviest and slowest piece took only 40 days for completion, the managers acquiesced for many years in a 9-month schedule, and after much special work felt pride instead of humiliation in a 6-month schedule. A 15-day schedule for general repairs to a locomotive is considered fast time and the average is more nearly 30, but if the time for each item is separately entered in a summary, it is hard to discover why 3 days would not be enough.

The battleship "Kansas" of the American Navy under an eminent efficiency commander went into dry-dock, water was pumped out of the dock, hull cleaned, scraped, painted, rudder post repacked, and the vessel floated again in less than 24 hours. For a steamer immediate repairs are otherwise important than for an isolated locomotive. The railroads, on the other hand, show marvelous speed, generally of the main-strength order, in clearing away a wreck or an earth slide or opening a snow blockade.

If a large publishing house could have freed itself from its own entangling traditions, it could have added a million dollars a year to its net income. The organization was tried out on some insignificant minor matters; it hesitated and balked and trembled for six months over what elsewhere was put into operation in six days and could go into operation in six hours, so the larger plans were not even submitted to it. A great superintendent of another plant had uncontrollable fear of boats of any kind; another large and successful manufacturer had fear of the subway in New York and could not be induced to go below ground. Similar fears overcome occasionally even the most wideawake men, and often the main obstacles in the path of progression are not the real and tangible difficulties, but the imaginary specters that terrorize and paralyze some part of the soul.

Ideals of standardized conditions are not utopian, but are immediately and intensely practical, but ideals must precede selective action. The Greek sculptors in their studies took a hand from one, a foot from another, the torso from a third, the face and head from others, and aggregated them all into an ideal; but this ideal existed in the mind or the sculptor could not have selected.

Who can tell why one hand is beautiful and another not, why one curve is pleasing and another disturbing? We recognize some forms of beauty as unerringly and without previous personal or race experience as we recognize that one note harmonizes with another.

It is far easier to demonstrate and to prove experimentally the value of standardized conditions than it is to prove beauty, especially for the small advances that are immediately possible, because all these advances are in successful operation somewhere; but often it is easier to break away from all traditions, to put the eye in the point of the needle, to load the gun from the breech, to write with both hands, to photograph instead of drawing, to make half-tones instead of engravings, to pick cotton by a whirling serrated pencil instead of with fingers, to turn over 640 acres of land with gang plows hitched behind mechanical tractors, than it is to improve on the old way.

The artist must have æsthetic ideals, the musicians, musical ideals; but the man who would bring about standardized conditions, either in himself or in his surroundings, must have conceptions of time, of effort, of cost; he must instinctively recognize that for each operation there is one combination of these three that is best for the ideal result. That ideal result may be an embroidered scarf which the lady with unlimited time, simple materials, and graceful, soothing effort has wrought. The ideal result may be the destruction of an enemy's battleship, twelve million dollars sunk in five minutes, by guns loaded, accurately aimed, and fired so as to hit, at the rate of two salvos a minute. Time minimum at whatever cost and effort!

In our individual lives, in our shops, in our nation, what are we trying to accomplish? Are we taking too much time, is it costing too much, are we squandering our strength? Are we standardizing conditions so that time will not be wasted, so that money will not be thrown away, so that effort will not be in vain?

XII

THE TENTH PRINCIPLE: STANDARDIZED OPERATIONS

Method goes far to prevent trouble in business; for it makes the task easy, hinders confusion, saves abundance of time and instructs those who have business depending what to do and what to hope.—WILLIAM PENN.

CHAPTER XII

THE TENTH PRINCIPLE: STANDARDIZED OPERATIONS

"HE talked to me for ten minutes, outlined enough work for ten years, and expected it to be completed in ten days." This is the concise summing up of an interview between an efficient worker and his employer. It is so easy to perceive shortcomings, so easy to plan work, so hard to realize that endless activity through endless time is the price of perfection. The hopefulness of humanity is not a recent development.

Moses came down into camp with his tables of stone and the ten commandments. It took one minute and fifty seconds to read them slowly and impressively. Moses expected that the tribes assembled would listen, practice, and become perfect before they reached the Promised Land. Thirty-five hundred years have elapsed and the breach of most of the commandments is still very popular. It is because the virtues extolled are not obvious, or instinctive, that they have to be graven on stone, that they have to be repeated weekly if not daily, that they have to be incorporated in our codes and enforced by our courts. Nature has ultimate ideals, but nature's creatures are not habitually idealists, reverent, kindly, clean, chaste, or honest. Ideals are so obscure that most of us do not know what ideals we hold. The warrior still holds an exalted and honorable position, not on account of his heroic courage, but on account of the potential carnage. The corners engineered in Wall Street, the ebb outward of enhanced securities, the flow inward of the same securities artificially depreciated, constitute a tolerated and even admired phase of modern business; and so it goes. Two minutes for orders—a life time, an æon, for realization! Can we wonder, therefore, that industrial operations are unstandardized—that the Moses who should lead the mob out of the wilderness flounders around for forty years, never arrives at all, and (if biblical accounts are correct) left as villainous a band of marauders, of Apaches, as ever existed to fall on the cities of Canaan? If this were all that the very great and extraordinary actual leader Moses could accomplish, need we wonder that the ordinary shop managers are not more successful?

We begin indeed with ideals; we expect end results; we leap over the intervening stations of the preceding nine principles, much as if we expected a train to run from New York to San Francisco with one helping of coal, water, lubrication, with one train crew. The rope is made of many minor strands; these are twisted from the numerous threads, and these in turn have been spun from broken and carded fibres. The sheep's fleece is a unit, a matted mass that adheres and forms a whole, not because it is woven like a blanket, but because of its interwoven confusion and tangle. There is no popular English word for a single thread of wool. Pull one lock and the whole fleece comes, not because of orderly connection, but because of disorderly tangle.

The march of a regiment is one thing, the surge of the crowd that jostles and sways us and upsets all orderly progress is another thing. The sheep is a silly creature, the only animal that would perish without the care of man, so no wonder its fleece is such a mess. The matted, tangled hair of some savages, hair plastered with mud, is comparable to the fleece, but civilized man settles the problem by clipping his head hair so that it could not tangle if it tried, settles his face hair by shaving off every vestige of it three to six times a week; but woman, more patient, with more capacity for taking pains, brushes and combs out her long locks, beginning at the ends, straightening a few inches at a time, then reaching higher up, rearranging all the parts already perfected, and so back to the head, until each of the 40,000 separate hairs lies in its own appointed place as to all the others, and all contribute to the marvelous and intricate creations that as a whole crown her lovely head. If it were not for the ideal plan the task would be hopeless. At least once a day does woman adjust her hair, the 40,000 single hairs to the general plan, and once a day should the 40,000 operations of the shop be straightened out in accordance with a general plan.

A comprehensive shop plan, graphically expressed, looks like a flattened tree. Each leaf, the separate operations, must be in order in its appointed place; each twig, with its own definite length, must reach in sequence into the main branches, these in turn being distributed at determined intervals along the main stem and trunk.

The trunk grows upwards and outwards, from the force implanted in the seed, the original ideal of the tree, but there is a reverse flow of imprisoned sunlight and captured carbon from the leaves back into the roots. The separate operations in a shop must flow into the final output; but from the expected output backward, there must be a plan that reaches back to each detail of every operation.

It is one thing to build a battleship taking up details as they occur—the haphazard method; it is another thing to make the plan first, place all the details where they belong in time, space, relation and perfection, and have them drop into place with the accuracy of a watch movement—the difference, in fact, between the running of sand through an unstandardized aperture, and the precision of the chronometer. Good results are not achieved by chance.

If we throw four dice with the hope of turning up four aces, we find that the chances are enormously against us. I learned this practically by costly experience and then figured it out mathematically. At a German country fair the fakirs had a disk divided into twenty-two sections, alternately white and red. The sections carried numbers from 4 to 24. There were two red sections with the number 14. The cost per throw of four dice was ten cents, but every white section was a prize winner; all the reds were losers. This looked fair, an even chance, except for the extra red 14, and as I gazed I perceived that the prizes were large, running from twenty-five cents to ten dollars. All I could possibly risk was ten cents; every other section was a prize winner and I might win ten dollars. I threw the dice again and again, but somehow or other the numbers I threw came between 9 and 19, and these were all red numbers, not anything as low as 8 or as high as 20, the lowest of the prizes. I lost the whole of the dollar that had been saved up for the day's enjoyment, for the miniature railroad, for the circus, for the other thrillers, and then I invoked mathematics. All the possible different throws of four dice are 1,296. There is one chance in 1,296 of throwing four aces, of throwing four sixes; there are four chances of throwing 5 or 23. There are one hundred and forty-six chances of throwing 14. The chances for the white numbers were 146, for the red numbers, 1,156. The chances against me were more than eight to one. The professional gambler wisely loads his dice so they will throw aces and sixes or at least come high. In the industrial operation the chance of the desired combination coming out of itself is just about the chance of throwing four aces.

We must imitate the professional gambler, and either select those combinations that will give us the inevitable advantage—that is, plan a board to suit—or we must load the dice so as to offset the chances against us.

There is only one game of chess. There is the board, standardized as to size, 15 to 16 inches square, just 64 squares, 32 pieces, each with its definite rights of movement. It looks like a very limited and standardized condition, yet possibilities of operation are so infinite that if all the inhabitants of the world played chess continually from now until the end of time, they could not exhaust all the variations, thus experimentally determining which was the best possible game, that one in which each player makes the best possible attacking and resistant moves, yet the total number of squares traveled is a minimum. It might be a long drawn-out game and it might be a short one—who knows, how shall we ever know? If, therefore, there is such infinite variety and possibility in chess, which has been played for centuries, how can we expect shop operations to standardize themselves?

I have before me one volume of the standard-practice instructions covering the manufacturing of the gasoline automobile truck car. It contains 278 isometric designs or illustrations, 314 pages of printed matter, and spaces for the times and rates of 1,231 distinct operations. Each one of these operations was preceded by many designs until one was accepted as approximately good. The design was split up into its component parts, investigation made as to material of each piece, how strong it should be, what heat treatment should be given, on what machines it should be shaped, in what sequence, by which worker. As to each piece and operation many time studies are made, and finally from the mass of accurately ascertained or available information, a carefully pre-studied work-instruction card is made out. All these items of planning must precede the time and cost ratings. Are you appalled at the mass of detail that precedes the making of a book? If we have but 100 copies to print it is cheaper, quicker, and better than manuscript duplication; if we have 3 copies to make it is better to choose the typewriter and provide carbon manifolds than to write it out by hand. If we want only 300 screws and it takes 3 hours to set up the automatic machine and only 3 minutes to run out the screws, it is better to use the automatic. A modern activity, whether the operation of an industrial shop, or a railroad, or of the turrets and guns of a battleship, is part of a gigantic, automatic machine; and it pays to plan in advance, not to trust to the haphazard.

Given the head of hair combed from childhood, never matted with clay; the head of hair to which daily the habit of neatness, great skill, and unrelenting care is applied—and the problem is solved. Given any activity in which planning has been incorporated as a habit, and apparent difficulties fade away before patience and persistence.

Nevertheless, the difficulties are very real and there is a middle ground between the optimism that underrates them and the despair that refuses to master them. There are between 8,000 and 16,000 separate pieces in a locomotive, and each railroad in the country wants a different design. One great railroad used 256 different styles of locomotives, so that there is an appalling lack of standards; but the more reason for beginning at once.

Modern watches are marvels of intricate and perfect construction. Any child can push a stick in the ground and by the position and length of the shadow determine approximately the time. A clepsydra or water clock, an hour glass, physical material leaking away at a uniform rate, was a decided advance at guessing on the time in the dark, or the time for boiling an egg. The early clocks with their pendulum escapements required many months of experimental test before length of pendulum, meshing of wheels, amount of weight, were adjusted to one another. There are as many different kinds of watches and clocks as there are locomotives; but each is perfect with a perfection so great as to be almost inconceivable. The jewelled bearings, the almost microscopic yet mathematically perfectly shaped teeth of the wheels, the hair spring, the balance wheel, each is perfect in itself, perfectly related to the others, until the whole is also perfect. This is not all. Delicate, automatic machines are made which turn out these perfected parts so exactly alike as to be interchangeable. Turret lathes and screw machines, automatic machines in general, were earliest adapted to clock and watch making, and from that extended to larger and heavier parts, often beyond the point of economy; for in watch screws the material, even if of gold, would not amount to very much, the perfection of finish being all-important, but as the weight of material grows with the cube of its linear measurement, we cannot afford to make on automatic machines crank-pins or even knuckle-pins for locomotives, it being too expensive to cut down the solid bar.

It would take no more thought and work to standardize operations for building a locomotive than for building a watch. The difference is that watches are turned out by the hundred thousands and locomotives only by the thousand; but this difference is not as great as it seems, for a watch movement may average $5 in value and a locomotive $15,000, so that one locomotive corresponds to 3,000 watches, and as we have not hesitated to undertake the work of designing each separate locomotive part, we need not fear the labor of standardizing the operation of manufacture for each separate locomotive part.

Another instance of standardized operation is the printing of a book. The old writers were individualists; there was no standardized operation. Each made not only the size of the letters to suit himself, but also their forms, took pride in not being like other scribes; each spelled the words his own way, each used his stylus or brush as he preferred, preparing his own ink, his own papyrus or parchment. Now we buy half a dozen newspapers a day for a cent each, we buy a dozen magazines a week for ten cents each, we buy a hundred books a year for a dollar or two each. Scarcely any two books are alike; there is far greater variation than in locomotives or watches; but each book is made up and printed with standardized spelling, standardized lines, standardized pages and standardized signatures; even the book itself approaches a standard in size. The ink is made to suit various fluctuations in the weather, the paper is made to suit the quality of the book in press. While printing is as yet standardized in a rudimentary way only, while it affords a field as large as any manufacturing business in the country, it has nevertheless in certain limited directions standardized operation to an advanced extent.

In the watch, in the book, we have the standardized operation as to the manner in which it shall be carried out; but there is another element—that of individual skill.

Two men may both show a model wall of brick, yet one man may have laid 3,000 bricks a day, the other man only 300.

"So true it is that one man and one intellect properly qualified for the particular undertaking is a host in itself and of extraordinary efficiency." Thus wrote Polybius, 212 B. C., in describing the work of that great engineer Archimedes, who, by his individual genius, flung rocks from catapults at the approaching besieging ships, who constructed cranes that let down grab hooks, lifted the ships out of the water, and turning them over, let them fall to destruction.

Horses have trotted and trotted well for many centuries, but it remained for Americans to figure out that the value of a minute might be rated at $3,000,000, and that to eliminate the minute, to evolve the mile-in-two-minute horse from the mile-in-three-minute horse would be worth this amount. Prizes were offered to crack trotters for beating their own record, $10,000 for the fifth of a second, and there are

300 fifths in a single minute. It was not only the horse that was developed; it was also the American stop-watch spirit, so that our fire fighters, whose every movement for men and teams has been standardized, are able to charge across the threshold of their firehouse 20 seconds after the gong has sounded. Less than the fifth of a second is said to cover the advantage of a runner to first base in modern baseball.

At an international contest in Berlin several years ago it took the English team over two minutes and the German team over eight minutes to make a start.

Now aeroplanes have come; and at the international meet in Belmont, true to our national virtues and our national faults, we were prepared to time the flights to the hundredth part of a second, but with a year's warning we had no machines wherewith to fly and we lost to the foreigners because we were unprepared.

Probably the most marvelous and valuable example of standardized operations anywhere in the world is on our American fleets in battle practice. The art of war has not changed as to its fundamentals since men first began to fight on land or sea. The purpose is with a stronger force to overwhelm a weaker opposing fleet, to strike first, hardest and quickest. It was Goliath's idea to pick off the Israelites one by one, and a modern pugilist could defeat a hundred men if they charged him singly, and he could down the first before the second came up. A Dreadnaught makes all the navies of the world without Dreadnaughts obsolete, because such a battleship with its ten 12-inch guns, can fire a broadside from all of them at once while steaming at 21 knots.

Such a battleship, steaming as fast as any rivals, bringing more guns into action than any rival, hitting an enemy at seven miles, could destroy the whole of an opposing fleet one by one, even as the pugilist would take the lighter weights one by one. But the horse-trotting, fire-fighting American stop-watch practice is also in the Navy, and it was realized that if these big guns could be fired four times as fast, it would be very nearly the same as having four times as many guns or four times as many Dreadnaughts, and also that if the skill of aim could be increased four-fold, if four shots would reach the target as compared to one in the older practice, one modern Arkansas or Wyoming, with twelve 12-inch guns, firing four times as fast and hitting four times as often, will, for the time being at least, be sixteen times as effective. These big guns are loaded, aimed, and fired twice in a minute. The practice drill is only half this time, and this practice drill is of two kinds. There is the physical act of loading the heavy gun, there is the more important act of pointing it. Two opposing ships are 10,000 yards apart (about 6 miles) steaming at 18 knots in diverging directions. The rate of change of range may be 750 yards a minute. If the range is set for every 50 yards, it must be redetermined every 4 seconds. This is impossible, but it can be determined every 30 seconds and a salvo be fired every 30 seconds. Being able to determine the range twice a minute, to fire twice a minute, the remaining part is drill in pointing or aiming, and this is done by means of much practice with models. To hit a target 60 feet wide and 30 feet high at 30,000 feet with a big gun, when you can cover it twice over by the point of a lead pencil at arm's length, is considerably harder than to hit a target 1 inch high at 83 feet with a small gun; but it is much better and much cheaper to fire 1,000 shots with the small gun than to fire the big gun once, and when the big gun is fired four times in practice, after training with small apparatus, it will do better than if firing 100 real shots without the model practice.

In the battle practice I saw the first 12-inch range-finding shot, from a distance of 14,000 yards, go clean through a 30 by 60 target; and so accurate and secure was the aim of all the salvos that we calmly watched the shots splash all around the floating target only 400 yards away. The firing end was not less impressive. The team work was so perfect that the salvos from the same ship were redirected one after the other almost with the ease with which a child swings a garden hose.

I have also watched diminutive and juvenile Igorot savages shoot dimes from a forked stick at 60 feet with bow and arrow. The Igorots show us the beginnings of offensive skill; modern American battleship target practice shows us the highest speed, accuracy, and distance yet attained, and we may not doubt that our present achievement is but a step in man's ultimate achievement.

The improvement in the effectiveness of the different ships of the Navy in the last five years is very great, and is probably the greatest improvement both in importance and magnitude that has ever been accomplished. Think of the small degree to which the steam turbine is superior to the reciprocating engine (a questionable 5 per cent), or how very little faster the best passenger trains are than the slowest of the same class (about 25 per cent). Think of the enormous expense in time and money spent in developing either steam turbines or high-speed trains—then think of the sixteen-fold increased efficiency of our battleships as compared to five years ago, an increased efficiency due to the application of the principles of efficiency—*all of them*—Ideals, Common Sense, Competent Counsel, Discipline, the Fair Deal, Reliable and Imediate Records, Schedules (of 10,000 yards), Despatching (of big shot at the rate of ten or twelve a minute), Standardized Conditions, Standardized Operation (secured by constant and assiduous team drill), most minute Standard-Practice Instructions (as to how fifths of seconds can be saved in time); finally, a joyful and much coveted Efficiency Reward, in both honor and emolument, when the tremendous results have been accomplished. And when this appears not only in the spectacular gunnery, but also in the more prosaic but continuously important operations of firing coal; of coaling ship (the record as to this having increased from 30 tons an hour to 360 tons an hour on some of the ships for the whole cruise around the world); of the maintenance of operation of machinery on board ship without going to Navy yards—these accomplishments show that high efficiency requires neither great outlay nor protracted time, but only the proper intelligence, spirit, and organization. The seagoing form of organization is admirably adapted to apply the principles, since a gun drill, a coal drill, a recoaling drill, is but a practical and modern form of drill. The ideal is not a mere dress parade, but to hit accurately, fast, and furiously, at the greatest distance, an enemy's ship overtaken by better management throughout; and this ideal has been accomplished, stop watch in hand refining all the conditions and operations, this refinement made possible by bringing to bear all the available knowledge in the universe. This Navy work is a great game, not drudgery; it is pleasurable excitement and joyously hard work.

Thus gradually, from all sides—from the watch and sewing-machine and typewriter factory, from the race-track, from the fire-fighters, from the manipulation of the big 12-inch guns, from schedules, despatching, standardized conditions and standardized operation in some shops—the methods of efficiency are spreading.

Planning pays; the application of all the principles of efficiency pays; but standardized operation is the principle that most appeals to the individuality of the man, of the worker. Ideals are passive, common-sense is passive, planning in all its phases is passive, but standardized operation becomes an individual joy with its wealth of active manifestation.

Let none hesitate because we cannot standardize each new operation. We cannot standardize every errand boy's every trip; we cannot standardize every naval battle; but we can so inspire both errand boy and admiral that each will always do his best, we can give them training, knowledge, help, and incentive; and if we do this for them and for all other workers, even though we cannot drill and redrill as to the performance of the occasional operation, we can be absolutely sure that no savable time will be wasted nor effort lost in performing it.

XIII

THE ELEVENTH PRINCIPLE: WRITTEN STANDARD-PRACTICE INSTRUCTIONS

Now hearken unto the statutes which I teach you, to do them, that ye may live. Ye shall not add unto the words, neither shall ye diminish aught from it. —*Deuteronomy*, 4, 1-2.

CHAPTER XIII

THE ELEVENTH PRINCIPLE: WRITTEN STANDARD-PRACTICE INSTRUCTIONS

THE human race is old and its upward progress slow; how old, no one knows. French, Italian, Spanish speech are descended from Latin dialects already differentiated twenty-four hundred years ago, yet the modern languages are so much alike that the educated foreigner, having learned to read one, can forthwith read and understand the other. Sanskrit, Greek, Latin, Irish, German, Russian, although developed from a common language, are so very far apart that it may easily have taken fifty-thousand years for their divergence. How far back beyond this time were the black, red, and white races one, how much further back when *homo sapiens* branched off? Egypt is historically the oldest nation, yet the beginnings of Egypt were on geologically the most recent of ground, the river bottom and delta of the Nile. Two hundred and fifty thousand years to bring about the difference between man and an ancestral being probably as intelligent as a chimpanzee! Counting three generations to a century, the human race has behind it 7,500 generations, and astonishingly little advance per generation to show.

The upward progress of man has been doubly hindered. Compared to animals, birds and, above all, insects, his brain cells mature very slowly. A dog two years old knows far more than a child of five, and a five-year-old dog usually has more wisdom than a man of twenty-five. The silkworm, the spider, the firefly, the bee, and the ant develop marvelous skill in a few weeks. The progress of insects is therefore due partly to the rapid succession of generations, a cause Darwin pointed out, and partly to the rapidity of mental processes in each short life. Man has intelligence, but it works with distressing slowness, and each generation has failed to transmit more than a very small part of the advance to its successor.

Rapid progress can be made in a generation. The child is born a rank animal, it is a savage until its fifth year, a barbarian more or less until maturity, yet ripens and mellows into a civilized being. When one considers medical students with their disreputable pranks and practices, one wonders where the comforting and respectable family physicians come from! It actually takes only thirty years to pass from animalism to semi-divinity, yet the race, after 7,500 times 33 years, is still far below this standard. Why has progress been so exceedingly slow? There have been high ideals in the past; there have been leaders of great common-sense, from the seven wise men of Greece to Franklin; there have been competent counsellors, the sages, seers and prophets, the sibyls and saints of all ages; there has been discipline, even severe, cruel, exterminating; there has been the fair deal taught by the Buddha and by the Christ, by the St. Vincent de Pauls, by the Elizabeth Frys, and by the Florence Nightingales; there have been records graven in stone; there have been plans, schedules and despatching; conditions and operations here and there down through the ages have been standardized—but all this has been spasmodic; little, so little has endured! There was no ratchet, the tide rose and fell, the children repeated the mistakes of their fathers; those full of years and wisdom became dust, and took their knowledge with them. We failed to hold as a genus or as a race what each individual had learned. Within the last five-thousand years there has been progress. The art of drawing, of carving imperishably, has transmitted a little of what our ancestors achieved and knew. More often, inspired with vanity, these great ones commemorated their own misdeeds. Knowledge was the carefully guarded secret of the priestly caste, but in the finally published sacred books, our own and other Bibles, we do find moral and practical wisdom written and transmitted. Printing, less than five-hundred years old, has been called the art preservative of all arts. That, of course, depends. Most of our daily papers and most of our books embody and preserve nothing of permanent value; they are merely an extension of the babel of Bander log, they are merely printed simian chatterings, but nevertheless printing has given us the possibility of creating an eleventh edition of the Encyclopedia Britannica.

Pumpelly tells a story of a Japanese student of metallurgy, who about 1870 possessed an English work on blast furnaces, an English-

Dutch dictionary, and a Dutch-Japanese dictionary, and with these as guides he constructed and operated a fairly successful blast furnace for smelting iron ore. This shows what can be done by Standard Permanent Written Instructions.

We have no accurate description of the engines of destruction invented by Archimedes for the defense of Syracuse against the Romans. They must have been interesting since they lifted whole ships and dropped them endwise into the sea or onto the rocks.

It would seem as if maps and charts would be an easy task. A stranger on an unknown coast, in an unknown land, an unknown city, knows more about it if he has a good chart or map than the native.

I have insisted that a map of Boston shall be properly oriented and displayed in our Boston office, for, excepting professional criminals who have to be versed in devious paths and ways, there is probably no modern Boston native who could readily and accurately lay a rational course from point to point in that city. Roaming and navigating savages who really need maps are very skilful in drawing them. Sir Edward Parry discovered Hecla Strait from a map drawn off-hand for him by an Eskimo woman; but the higher the civilization of the map-maker, the more in the past he substituted imagination and arts for facts. There are Egyptian maps dating from 1400 B. C., but in spite of this long history it has been astonishingly difficult to make progress in charts until very recent times. Errors are perpetuated, truth is forgotten, advance is slow. As late as 1900, charts of the Alaskan coast issued by the United States were said to be thirty miles wrong, and nearly all commercial map makers still represent mountain chains as caterpillars, and the fringe of the shore is adorned with a blue wavy frill. As for railroad maps, the less said the better.

The early land-survey maps of our western plains were concocted in central offices, not on the ground; therefore on the Colorado and Nebraska line they do not tie in by four miles and a half east and west. The Government paid the full price for accurate surveys, but with a man in charge of a keg of whiskey galloping ahead on a mule, with several investigating Indians in war paint galloping behind, burnt matches stuck in the ground did duty as the required and sworn to charred stakes.

The maps made from the surveys were not standard permanent instructions of much value. Modern geodetic and geological-survey charts, modern coast-survey charts, are admirable and useful beyond criticism; but it has taken a long while to reach this perfection.

On one occasion I was invited to invest in a gold placer in Wyoming to be washed out by hydraulicking. The geological-survey contour chart showed conclusively that it would be impossible to secure sufficient water with sufficient head to wash the gravel. What has been done with the prospect since dredges have been put into successful operation I do not know. On another occasion I reported adversely on an Alaskan ditch proposition. The watershed tributary to the ditch was easily integrated from the Government contour chart, the yearly precipitation was also known. The promoters claimed 5,000 miner's inches; I could not figure more than 500; investors nevertheless went ahead. The next year they reported that the season had been one of unusual drought, and the year after that the company was in the hands of a receiver.

American law is in most States the outgrowth of English common law, and in our

Spanish and French States, of Roman law. The common law in England is the outcome of custom finally passed on by the courts or defined by acts of Parliament. In many of our State codes we have attempted to reduce the principles to statutes governing particular cases. This is often helpful and often not. Moses laid down principles: Thou shalt not kill; Honor thy father and thy mother—but the enforcement became specific. Codes supplemented principles.

"If any man smite his neighbor mortally, then the elders of his city shall deliver him into the hand of the avenger of blood that he may die."

"Thine eye shall not pity, life for life, eye for eye, tooth for tooth, hand for hand, foot for foot."

"If a man have a stubborn and rebellious son all the men of his city shall stone him with stones that he die."

It was from snap decisions in specific cases that the laws of the Medes and Persians grew up, laws that changed not.

Lord Wolseley credits Napoleon with the greatest intellect the human race has ever produced. Bonaparte, First Consul, personally worked over the wording of the Civil Code. He wanted its provisions so clear that even the most ignorant peasant could understand. As French is an admirably definite and clear language, as the French have a passion for logic, as the greatest legal minds of France aided and were aided by Bonaparte in evolving this code, it furnishes an admirable example of Permanent Written Standard-Practice Instructions. It was, moreover, only one of seven great organizing acts which he made into specific standard-practice instructions, these instructions having persisted almost unchanged to the present time.

The standardizing operations, the ratchet action, is of very great importance. A python will swallow a deer, a garter snake will swallow a large frog. The snake's teeth are set slanting backward. One jaw moves forward over the flesh, takes hold and draws until the other jaw can slip forward and sink the curved teeth in. In this way the large body is drawn into and forced through the small gullet. The more difficult the operation the less is there any slip back. It is easier to draw a fish hook through a wound than out of it. In most human affairs efficiency is in the end gained by going forward and through rather than by struggling forever on the near side.

An American weakness is to be discouraged by difficulties and to back-water instead of overcoming troubles and going forward. All the world knows that compound steam-engines use less coal and water than simple engines. The compound principle was successfully applied in France and Germany to locomotives. The steam pressures were naturally much higher. American railroads rushed into compounds with inadequate preparation, knowledge, or designs. Difficulties of all kinds developed, due partly to the high pressures, partly to the added dependent and increasingly inefficient sequences. A case dwells in memory in which it took 80 hours to renew an intermediate packing. Compounds as tried proved expensive and troublesome both to operate and to repair. Instead of being perfected as in France and in Germany, in order to gain the advantages of the principle, they have been abandoned by American roads almost without exception. Temporary expediency governs—not ideals.

The marvelous results due to standardization of gunnery practice in the American fleet have already been referred to. These results were achieved by the ratchet process, by holding onto every gain and by never allowing any slip back, these results being secured by a voluminous book of instructions and suggestions. In this book best ways as ascertained to date are specifically prescribed, by written, permanent standard-practice instructions, but these instructions are subject to a bombardment of suggestions and all these suggestions, however foolish, are tabulated, printed, and confidentially published.

The grains of wheat are winnowed from the chaff, common sense finds its own reward in approval, and the makers of foolish suggestions are ridiculed and shamed by their own comrades. Those in charge of these instructions, of the analysis of practice and results, waste no time in finding out what European rivals are doing. They know that the way to discover the North Pole is to go there as fast as possible, not to waste time and money watching the preparations of others; they know that the way to shoot quick and straight and far in a heavy sea is to attain high speed and shatter targets at long ranges, rather than to spy on what the other fellow is about.

The feeling about this naval practice is akin in spirit to the attitude of an American grain exporter who showed a Hungarian investigator our whole elevator and grain shipment installations, from the wheat fields of Dakota to Atlantic steamers. He was asked, "Why do you show foreigners, future competitors and rivals, our methods?" "Because they can't understand half they see, they can't remember half they understand, and by the time they have copied all we have, it will be obsolete with us and we shall be ten years ahead." This applies, however, equally to our own backwardness compared to foreigners in so many other directions. The way to forge ahead is to get busy, not to copy.

It is not only in its charts, in its naval gunnery, in its agricultural department, that the United States Government has established permanent written instructions.

The specifications of the purchasing department of the navy are at once the most complete, the most modern, and the best I have ever seen. That the plans were evolved and perfected by graduates of Annapolis speaks highly for the practical value of the general education there imparted.

There are many hundred different specifications covering everything that the navy regularly uses; the specifications for eggs covered several pages; the specifications for potatoes are as follows:

Potatoes, Irish (East Coast) in sacks or barrels.—To be selected stock of standard market sorts, sound, fresh, free from scab and mechanical injuries. One price only shall be quoted by bidders for both old and new potatoes, either of which may be delivered at the option of the contractor. Potatoes shall measure not less than 2 inches in smallest diameter.

To be delivered in either sacks or barrels, according to the ordinary commercial usage of the locality in which delivery is made. Each barrel or bag to be marked with the net weight.

Copies of the above specifications can be obtained upon application to the various Navy pay offices or to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

When advances are not only definitely recorded but when the best practice is carefully and systematically reduced to writing, progress made is held and built upon in an industrial plant or any other undertaking. Every shop, every institution, has its great body of common-law practices that have gradually crept in, common law variously understood and variously interpreted by those most affected. Often the traditions of the past are treasured up in the brain of some old employee, who transmits them, much as the memories of old bards were formerly the only available history.

We have known foremen to refuse deliberately to tell a new official how certain work was done. The defiant stand assumed was that this was a personal secret. The history of brass castings is filled with these secrets of compositions. An English tool forger pretended he could smell good steel and he imposed the same conviction on his employers. Whenever, in any plant, Bonaparte's most lasting work is undertaken—namely, written codification of current practices—it is astonishing how much is found that is contradictory, how much is vague and indefinite, how much is involved and complicated that might be direct and simple, how much is wholly lacking.

Each one of the ten preceding efficiency principles can and should be reduced to written, permanent standard-practice instructions so that each may understand the whole and also his own relation to it. In some plants the only rules obtainable or visible are certain subsidiary conduct rules, offensively expressed and ending with the threat of discharge.

I remember a wily superintendent who, when asked by a manager to post some additional offensive rule, modestly suggested it would have more force if signed by the manager himself. The latter fell into the trap and posted the rule, which was soon obliterated by abusive and scurrilous amendments, comments, and epithets. The superintendent himself did not lose prestige. The ideals of a plan or undertaking can be expressed in a few words. One of the mottoes of American naval practice is: "Efficiency and Economy." This is amplified into special rules governing all kinds of activities. I have before me the following:

NAVY DEPARTMENT
Washington, April 22nd, 1911.

Attention is invited to General Order No. 36 of August 20, 1909.

G. v. L. MEYER,
Secretary of the Navy.

The effort to save coal shall not be allowed to diminish the efficiency of the ship or to affect adversely the health or comfort of the personnel. It is strictly forbidden to save coal by curtailing the use of the turrets or steamers or by unduly reducing light, ventilation, or the supply of fresh water.

It is to be noticed that the rule is not one of spur toward higher effort, but to hold back the over-zealous; it is not one to stimulate the inefficiency of depression, but to restrain the over-efficiency of joyous exaggeration. It is not a rule "that enforces a high-speed process in which none but the strong survive," but it is a rule protecting the interests of all.

Discipline and the fair deal do not require voluminous initial instructions, although both discipline and the fair deal should curtail automatism.

Standard-Practice Instructions are the permanent laws and practices of a plant. What these laws, practices and customs are should first be carefully ascertained and be reduced to writing by a competent and high-class investigator, and it will be all the better if he has had legal training. It will take considerable work to find out what the practices are, as different officials from president down may have different opinions and theories and also the practice may vary from month to month. It is quite usual to find the actual practice quite different from what the general manager or president supposes it is. Men do what they can, not what they have been told. The purpose is to find out what current practice is, not what it is supposed to be.

The next step in the work is to harmonize the discrepancies, to cut out what is useless or harmful, and to supplement the resultant body by needed additions.

When this constructive work has been performed there will be a preliminary code. In actual practice it will be found that it is still defective, incomplete or contradictory. It is to be made workable not by throwing it to the winds and reverting to the previous state of semi-anarchy every time a difficulty arrives, but by carefully considered amendments. The code being made up of a number of different statements and enactments can be amended by sending out notice of withdrawal of any enactment, at the same time issuing the amended enactment, the substitution being effected as in the illustration that follows:—

On and after receipt, substitute Rule 5a, dated June 1, 1911, for Rule 5, dated September 28, 1909. Read carefully the new rule, note the changes made and send signed receipts to head office.

The maintenance of the code is the duty of a qualified, interested minor official to whom all suggestions should be referred. The code itself is not his creation but the outgrowth of the plant's operating needs. The code goes out over the signed signature of the highest available official. There may be supplementary signatures of the department officials. For example, rules for the installation and maintenance of belting should be drawn up by the official in charge of maintenance, should be collated and put in standard form by the codifier, should be promulgated over the signatures of the superintendent, of department head, even of belt foreman as well as of general manager or president. The belt foreman's business, if he does not like the rules, is not to sign them until he has fought the matter out, but it is not his business to disregard them. The natural inclination is to prefer individual anarchy, but anarchy never leads anywhere.

In time quite a body of standard-practice instructions will grow up, most of them suggested and evolved by the employees. Records will require many pages of specific instructions, if the records are to be reliable, immediate and adequate. Standardized conditions also ultimately require a large volume, but the largest volume of all is the book covering standardized operations. It is pathetically and ignorantly supposed that standard instructions destroy a man's initiative and make of him an automaton. Compared to the drop of the sparrow through the air, or the scamper of the squirrel down a tree, a staircase does indeed limit the initiative of a man going from the roof to the ground. He who prefers it may let himself down from the window by a rope. I prefer the limitation, common-sense, safety and ease of the staircase. A ferryboat limits the initiative of a commuter entering the city and a tunnel even more limits this initiative. Those who prefer it are welcome to the right to swim the Hudson or to use a small skiff of their own. The flanges of the locomotive and car wheels confine the train to the steel rails, and this is a great curtailment of initiative compared to the free path of the buffalo or of the bull-whacker across the plains.

The fact is that the limitation of initiative professedly so dreaded is wholly imaginary. To follow the better and easier way is to lessen effort for the same result, to leave more opportunity for higher initiative to invent or evolve still better ways.

The aviator flying 72 miles an hour is the greatest initiator in the world to-day, yet to a degree never before experienced he is limited by his engine, and nothing would be so welcome as standard-practice instructions that would help keep his engine going, as automatic stability for his plane, gladly relinquishing his own initiative in favor of tested standard practice in both these respects.

Any undertaking run without written standard-practice instructions is incapable of progressive advance, but by means of written instructions advances far more rapid than those attained by insects and birds are possible. Wireless telegraphy is but suggested, experiments described, and inside of ten years our coast is fringed with the masts of rival systems and messages are transmitted across the ocean! The first flights of aeroplanes were but eight years ago, and to-day they are carrying twelve passengers or flying 72 miles an hour. Five years of planned, attained, and recorded progress will accomplish more than twenty years of rule of thumb tucked away under the hats of shifting employees.

XIV

THE TWELFTH PRINCIPLE: EFFICIENCY REWARD

"When I heard," said the Badger, "that the money you needed was to be offered to a temple for your soul, I went to the island of Sado, and gathering the sand and earth which had been cast away as worthless by the miners, fused it afresh in the fire; at this work I spent months and days, and here it is for you."—*Tales of Old Japan.*

All that the doctrine of equal rights can hope to accomplish is that the man who is most deserving shall be placed where he should be. Until the last page of the last volume is written in the Book of Years, Merit alone will rule the earth.—HERBERT KAUFMANN.

There is nothing men will not attempt when great enterprises hold out the promise of great rewards.—LIVY.

Withhold not good from them to whom it is due, when it is in the power of thine hand to do it.—*Proverbs,* 3, 27.

CHAPTER XIV

THE TWELFTH PRINCIPLE: EFFICIENCY REWARD

PUZZLES:—The themes of fairy tales! To sort out the tangled skeins of silk, to separate the colored grains of sand! Puzzles:—to decipher the hieroglyphs and the cuneiforms, to tax all the powers of investigation, of theories, of analysis, of philosophy, of interpretation! Solutions, generalizations, are fascinating.

Books, encyclopedias of 50,000,000 words, 250,000 words in the English language, outside of dictionaries scarcely 10,000 different—but only 26 letters of the alphabet; these again reduced to three classes, labials, dentals, palatals, each shifting from dialect to dialect as in *pater*, *vater*, *father*, all the languages of the world synthesized back to *mama*, *dada*, *gaga*, further back even to the unconscious ejaculations of the newly-born child!

Millions and millions of different substances in the world! There are countless different kinds of oil alone, all consisting of carbon, hydrogen and oxygen. Vary the proportions of the elements, and the compounds shift into alcohols, sugars, starches, dextrines, acids—into essences, aromas, into dyes, drugs, poisons! All the substances in the universe are but combinations of less than seventy elements, and it is the dream, the expectation of modern chemistry to find whether these, if not but one, are not at most three or four.

In the last analysis, it is the marvelous simplicity of it all that enchants, almost stuns. Gravitation holds solar systems in their paths, carves the face of the land, calms the ocean's unrest! Crystallization gave us glacial epochs, life gives us biology, zoology, history, philosophy. Compared to life, physical, psychical, mental, all else seems simple; yet how few the instincts to perpetuate and develop life! The instinct for immediate life, the instinct for eternal life, the preservation of the individual and the race—yet both these instincts are maintained and stimulated by one single principle, the last of the twelve, the principle of "EFFICIENCY REWARD."

For years there has been the unanswered question: "What is the difference between the dead and the living, between the animate and the inanimate?" Whatever responds to an efficiency reward is alive; what cannot respond, is inanimate. There is a difference between the drop of water in obedience to the law of gravitation, descending from the mountain top to the sea, and the pine tree growing tall and slim that its needles may reach the light and live.

Darwin showed that life was preserved and developed by the survival of the efficient, by natural selection—that individual variation due to the survival of the efficient was transmitted by sexual selection. Nature is accused of caring nothing for the individual, of caring much for the race, yet she moulds impartially all individuals and all races by offering and paying efficiency rewards. There is for every individual, for every race, destruction, hell-fire lurking everywhere, but it is the efficiency reward that tempts us far from the danger zone. Take away the stimulus of efficiency reward—individual life and race life would vanish from the earth!

We can smile at those who in their ignorance try to nullify the principles of efficiency reward, to banish it from human affairs. Yet man, because he perversely went backward into darkness rather than forward into light—man who is what he is because of high reward for individual efficiency—forgot the principle that had made him, forgot that it was eternal and that ever greater rewards were still ahead, and tried to hold exclusively what he had and to enhance its value by depriving others of what had been given him. The priests of all ages, those to whom it had been given to read some pages of nature's open book, immediately made mysteries of this knowledge, tried to put the book under lock and key. Dynasties which had reached their kingship through individual efficiency—the Carolingians, the descendants of the pawnbroking Burggrave of Nuremberg, the Tudors, the Bourbons, immediately substituted for the principle of efficiency the artificial principle of the Divine Right of Kings, of kingship by the Grace of God. Men who, like David and Solomon, ought to have known that there was supreme joy in winning the love of one woman, whether Bathsheba or the Queen of Sheba, immediately laid in (by the mercenary path, not by means of emotional efficiency) whole harems of useless atrophying women, David's chief pleasure apparently being to shut them up in remote and distressful seclusion for the mean pleasure of watching their lives waste and of depriving other men of wives (see II Samuel, 20:3). All nature shows that innovating efficiency is the direct effect of reward, but the history of human institutions shows that these are chiefly devised by the selfish few to appropriate rewards without efficiency, yet coating the pill by holding out the lure of a remote and hypothetical reward for efficiency to those who bow the knee in service, to the deluded many.

Thus is offered by the priests the promise of heaven to those who yield to the demands of the church, by generals the promise of Paradise with houris galore to those who die in battle, by kings the promise of occasional largesse and festivities to those who pay taxes and otherwise serve, by guilds commercial success to members, by unions fixed wages for inadequate work to those who join them.

The early settlers in America had fled from caste. They had left it behind them. The efficient came to the new land of hardship and promise, and the efficient earned their individual rewards. When they set up their government, they made no provision for the State church, they abolished all titles and hereditary offices, they provided for no standing army, there were no interstate barriers to trade and free movement, and there were no guilds. The apprentice became journeyman, the journeyman became master, the master became head of a plant. There were so many opportunities that the caste principle of fixed day's wage without reference to performance was overlooked. The master with his few workmen under him could personally supervise and promote or discharge. Yet the iniquity of the fixed rate per hour was clearly indicated 1,900 years ago, in the parable of the laborers in the vineyard. A householder went out early in the morning to hire laborers, and when he had agreed with the laborers for a penny a day he sent them into his vineyard; and he went out at the third hour, and again at the sixth, the ninth, and the eleventh hour and saw others standing in the market place idle, and to them he said, "Go ye also into the vineyard and *whatsoever is right* I will give you." This promise of receiving what was right—pay on the basis of performance, not on the basis of time—stimulated the workers, and even those last engaged did as much work before stopping as those who had been making a slow pace through the twelve-hour-long scorching and burdensome day.

> So when even was come, the lord of the vineyard saith unto his steward, Call the labourers and give them their hire. . . . And when they came that were hired about the eleventh hour, they received every man a penny. But when the first came, they supposed that they should have received more; . . . and they murmured against the goodman of the house. . . . But he answered one of them, and said, Friend, I do thee no wrong: didst not thou agree with me for a penny? . . . Is thine eye evil because I am good?

The day-wage system, contrary as it is both to the underlying principle of efficiency reward and also to all principles of equity, since it lacks any intelligent relation between pay and performance, is doomed, in spite of hoary custom, current practice, in spite of combined (although opposed) efforts of unions and employers' associations. Compensation for work cannot remain an exception to the general law that there must be a definite equivalent, based on the two elements of quantity and quality; and our ability to measure accurately both quantity and quality, whether the weight in carats of the diamond and its blue-whiteness, whether the weight of coal and the heat units per pound, is one of the measures of civilization. In all the ten-thousand years before coal, during which the human race warmed itself and cooked with wood fires exclusively, there is probably not a single instance in which any exact heat-unit equivalent and price demanded or paid was determined. The same happy-go-lucky vagueness was transmitted to coal purchases, and even yet most coal is purchased without reference to analysis.

Wiser buyers, large consumers, purchase on specification sustained by analysis and verified by test. A coal that looks like another may be worth only one-tenth as much. Before Archimedes discovered the relation of weight to bulk, the principle of specific gravity, before he experimentally determined the relative weights of water, gold, and silver, goldsmiths had a joyous time swindling their customers, since it was only by color that the value of the worked-up metal could be judged. It speaks well for the general honesty of the ancient coiners that the old silver and old gold coins are so pure. This blind trust as to quality would not work today as to metals, does not work as to coal, will soon not work as to wages. It was pondering on the problem of detecting a suspected swindle that led Archimedes to the discovery of specific gravity.

Efficiency rewards hold good for nearly every worker in life except the day worker. The girl who makes a business of it, secures a valuable husband, an enormous and permanent reward for a very few days of competent endeavor. This is the oldest competitive business of all, and results in a trust greater than the Standard Oil, greater even than the Catholic Church.

The hunter who starts early, who has practiced much, who works hard, brings home the game. The farmer who selects his seed carefully, tills and fertilizes his crops scientifically, secures twice the yield per acre; the merchant who hits the fancies or the necessities of the buying public becomes rich; the lawyer who wins cases charges heavier fees; the doctor who has made a name for himself charges fancy prices for very simple operations; the clergyman who is eloquent receives a call to a larger church; the politician who stands in with the boys attains ultimately to a senatorial toga. Everywhere—except for almost the largest class of all, the men who work with their hands—there is special and closely connected reward for individual efficiency. Are the toilers to have no efficiency reward? The inducement is held out that if they join unions they will receive day wages—high day wages—short hours, and that they will not have to work hard. Permanence of pay, which is far more vital than rate of pay, is not guaranteed. It is the earning in a working lifetime, divided by *all* the days, that counts, not the nominal wages per day. In the modern industrial state initiative must not be destroyed, separate action must exist; there must be individual as well as collective bargaining; the individual must also count; the guild is not everything. I have no antagonism to unions. They have been and are still very necessary; they have mitigated the tyranny of the employer and of his irresponsible foremen over helpless, because divided, workers. Unions should be supported in their every effort to make the work of women and children unnecessary. Unions have demonstrated in many instances that very high rates of pay per day are compatible with flourishing business for the employer. By establishing and maintaining a scale they have done an eminent service in preventing a blind slashing of wages below the living limit, in order to lessen costs, high for reasons not connected with wages. Unions have accomplished much. Coming to the subject from a different point of view, I agree with them in their attitude toward piece rates, which are intended to stimulate strenuousness, often harmful strenuousness, the exact opposite of efficiency; but as to a fixed rate of pay per hour or day without reference either to equivalent or to individuality, the whole teachings of the ages, the whole tendency of the time, are against it. We can well excuse churches which try to maintain their tottering sway; we can excuse dynasties who inculcate the divine right of kings; we can excuse guilds like the stock exchange which attempt to limit all the business of its kind to their own members; but it is one of the tragedies of this era of discovery and invention, this era of the looting of natural resources of the universe for the sake of man, that justice, the protection of equivalent, should be denied both employer and employee, and the reward of individual excellence be denied the worker.

Never before were fairness, justice, knowledge, accuracy, so much needed. A hundred years ago, except for a few sailing ships, windmills and waterwheels, and a very few cards steam-engines, all the workable energy of the world came from the muscles of men and domesticated animals, the slow man and the slower ox or ass. Men and animals ate today what the season's sun prepared for them. The energy was incarnate. In the last hundred years we have tapped the reservoirs of energy accumulated, stored by the sun in former ages.

We are like a young man until recently on scant allowance who has suddenly inherited an immense fortune. In the United States the uncarnate energy used is thirty times as great as was the incarnate energy sixty years ago; it is as if each head of a family had inherited thirty slaves forced to labor for him without pay beyond the obligation to maintain. It is increasingly less the hard muscular labor of the hands and body that counts, it is more and more the intelligence to direct mechanical slaves that counts. The man who smashes a machine because he fears it will take his job, the man who refuses the promotion due him for efficient control, misses the richest gift that any generation has ever been offered.

Efficiency reward cannot be equitably offered to the worker until equivalency is first conceded and established. The basis of equivalency is of little importance compared to the principle. There is no moral objection to employers and employees agreeing on a minimum wage rate and maximum length of workday, but nevertheless an equivalent for the day's pay should be set up in work—a definite, carefully determined equivalent. In bricklaying, for instance, if 400 bricks is agreed to as a layer's output for a day, and $4.00 is the wages for 400 bricks, and if it is further agreed that he may not lay any more, then, if with the help of modern science he can lay the 400 bricks in a single hour, let him lay them in that time and return to his garden or to the companionship of his wife and children, and let other workers take his place during the daylight hours.

In the words of that three-thousand year old proverb, "Whatsoever thy hand findeth to do, do it with thy might, for there is no work, or device, or knowledge, or wisdom in hell."

The trouble with piece rates was that they attempted to solve, by a crude application of the principle of strenuousness, not an efficiency principle, a number of problems that could be solved only by the application of many efficiency principles. Ideals were not clearly seen, common-sense was not invoked, competent counsel was not secured, discipline and the fair deal were equally neglected, as cases are known in which piece workers had to begin work at 5 a. m. in order to make a day's wage. Reliable records were lacking, there was no planning, no despatching, no standardized conditions and no standardized operations—only arbitrary piece-rate schedules, a day rate of average current wage to the phenomenal worker being the ultimate measure of the piece rate.

The first strike recorded in history was a strike against a cut in piece rates.

> And the Egyptians made the children of Israel to serve with rigour: And they made their lives bitter with hard bondage, in mortar, and in brick, and in all manner of service. . . . And Moses and Aaron went in and told Pharaoh, Let the people go, that they may hold a feast. . . . And the king of Egypt said unto them, Wherefore do ye . . . let the people from their works? . . . ye make them rest from their burdens. And Pharaoh commanded the same day the taskmasters, . . . saying, Ye shall not more give the people straw to make brick, as heretofore. . . . And the tale of the bricks which they did make heretofore, ye shall lay upon them; ye shall not diminish ought thereof: for they be idle; therefore they cry, saying, Let us go . . . Let there more work be laid upon the men . . . and let them not regard vain words. Pharaoh said to the children of Israel, Ye are idle, ye are idle: . . . Go therefore now and work; for there shall no straw be given you, yet shall ye deliver the tale of the bricks.

What followed is a matter of history. They walked out and stayed out for forty years, and then their descendants got other and better jobs.

Piece rates, resting on a wrong and vicious principle, are too crude a device ever to be permanently satisfactory. The time required for a given task varies with the general overhead conditions, varies with the condition of the machine, varies with the quality and excellence of the tools, varies with the hardness of the material worked, varies with the number of pieces to be made, and finally varies with the experience, strength and skill of the operator.

If all conditions have been standardized, if rates have been based on times carefully, scientifically, and impartially determined, if there is a guaranteed rate per hour in case piece rates are for any accidental cause too low—then an efficiency piece-rate system may with difficulty be made tolerable.

A profit-sharing plan is not an efficiency reward. Out of the eighteen items of operating costs or manufacturing costs, as distinguished from selling costs, only one is directly influenced by the worker, and that is the time-quality of his work. For the other seventeen items the management is partly responsible, but often many of them are beyond the control of either manager or worker—the prices of materials, for instance. These are often the largest part of the cost.

In building locomotives the costs of direct labor are 15 per cent, the overhead expense 15 per cent, and the material cost 70 per cent. This does not include any general office expenses or selling expense or profit. In another plant the raw materials amounted to $32,000,000 a year, the labor costs to $600,000, overhead to $400,000. In this latter case, assuming a manufactured product of 360,000,000 pounds worth $0.10 a pound, and a selling cost of $1,000,000, there would be a profit of $2,000,000 or 5.5 per cent, about $0.005 a pound. Let prices drop five mills and profits are wiped out; let prices rise five mills and profits are doubled; let an efficient management reduce material wastes one per cent and the added profit is $360,000. Let labor deliver twice as much work for the same wages and the gain is only $300,000.

Equity demands direct connection between efficiency reward and efficiency quality. A distribution *pro rata* to wages at the end of the year, to bad and good alike, of a profit due always in largest part to causes over which the worker has no control, is illogical although it may be kind. What direct incentive is there to a good worker to put forth special effort when all the efforts of all the workers can be negatived by a slump in the market price? What direct incentive to put forth special effort when the laziest and the most wasteful will be given the same proportionate reward? An efficiency reward is one which the worker can see and grasp during the effort, one that is paid to him for his individual excellence in that for which he is individually responsible. What incentive would there be to owners and jockeys of race horses if instead of stakes, competed for and won at the post, a small portion of the gate receipts were distributed *pro rata* at the end of the season to all, including the also rans? What incentive would ball players have to manifest individual excellence if, at the end of the season, all shared *pro rata* in a bonus more dependent for amount on the weather than on their efforts? Would it be an efficiency reward to offer fruit packers a bonus based on the price of the yield when a single frost may destroy the whole crop, or suitable weather double it, with prices affected by competitive product grown three thousand miles away, as Idaho and Washington apples competing with New York fruit?

Profit sharing is not inequitable as are piece payments; it is an amiable kindness on the part of the plant owners, but it is not efficiency reward.

There are, however, forms of bonus above guaranteed wages that are free both from the inequities of piece rates and from the colorless amiability of profit sharing.

The worker sells two different possessions, both his own—his time and his skill. He should be robbed of neither. Time payments which make no allowance for skill are wrong; skill payments which make no provision for time are also wrong. It is easy to measure time. We can do it with the watch that made the dollar famous. In horse racing, time is used exclusively to measure skill. The horse that is able to clip a fifth of a second from a world's record, may by that act add $10,000 to his value. Skill may also be measured in time. In the battle practice of the American fleet it is more important to fire 120 rounds an hour and make 10 per cent of hits, than to fire 12 rounds an hour and make 50 per cent of hits.

Mr. F. A. Halsey, in his premium plan under which he guarantees compensation per hour irrespective of product, and in addition pays a premium of one-third pay for all time saved over previous records, laid the foundation for rational efficiency reward. As usually put into practice the plan is imperfect, because the dividing point between day wages and premium addition is carelessly accepted without scientific or reliable accuracy. It reminds one of the German's measure of road distance, the *Stunde,* or hour, which conveys no meaning unless one knows what kind of an animal and the habitual speed shown for an hour. In the centuries before *Stunde* was a measure of distance, Cæsar's *millia passuum*—the thousand steps of the soldier—were used as a measure of time; very accurate as to distance, not bad as to time, as there were no railroad trains to catch; but before the days of clocks, a measure of distance based on guess of time on a cloudy day was not a unit of record either reliable, immediate or adequate. There are minutes that seem like hours, so wearily do they drag; there are hours that fly like minutes, each minute holding more than other days.

F. W. Taylor's immense merit was that above everything else he insisted on the necessity and possibility of determining very closely the upper limit of high and rapid performance under normal conditions, a performance that could be kept up for years or for a working lifetime without detriment to the worker, yet that eliminated the flagrant or avoidable waste. Taylor thus laid the founations for equitable bonus for each operation to each individual.

Gantt was the first to evolve and use in the compensation of workers a plan that retained full pay by the hour (therefore pay for time *quantity*, a definite original recompense) and pay for time *quality*, for a specific task, for which a most carefully ascertained time had been determined. No reward was paid unless full time quality was realized. It was on the principle that a fisherman either caught his fish or he did not; there were no half or quarter fish for near skill in angling.

Many of nature's efficiency rewards are of this character, and it is a strong, virile principle.

The author, owing to the nature of the work in the plants he was counseling, found it undesirable to make the line of demarcation so sharp between efficiency and inefficiency, and therefore followed nature's softer plan of efficiency reward. Every plant or animal must maintain a certain minimum of efficiency or it dies; atrophy results in extinction; but above this lower limit, reward is proportioned to efficiency—small reward to the less efficient, special honors to the most efficient.

The principle of the wage target with a small bull's eye is applied. Shots outside of the bull's eye but in the target also count.

In the original plan, while certain operations averaged four hours under the same workman working with the same diligence, on one occasion the time would be five hours and on another three hours, owing to conditions over which the worker had no control. It was highly desirable to maintain the interest of the operator in the discouraging jobs, so while a standard bonus of 20 per cent was paid for attaining standard time, while 10 per cent bonus was paid for attaining 90 per cent of standard time and 3.25 per cent bonus for 80 per cent of standard time, bonus stopped at 67 per cent of standard. If less time than standard was used, the worker was paid at his full hourly rate for all the time he saved, and was paid in addition 20 per cent bonus for the time that he worked. A workman had to be very inferior who could not regularly earn some bonus. A further step to eliminate accidental and inevitable time variations was suggested and worked out by two advisers, Mr. Playfair and Mr. Whiteford, who have both made for themselves names in efficiency work. Under the new plan the worker is charged with all the hours he works in any selected period, week, month, etc., and he is credited with and paid for all the standard hours of work which he turns out. The bonus, whether for job, for day, for month or longer period, is paid on the efficiency relation between actual and standard. If a worker is present 250 hours in a month and turns out 250 hours of work in 250 hours actual time, his efficiency is 100 per cent, and he earns 20 per cent bonus on wages; but if in the same time he turns out 300 hours of work, his efficiency 40 per cent on his wages.

The standard times are most carefully determined by time studies, by observations, by theoretical considerations, by demonstrations, using every available method to establish fair and correct standards. If the performance is walking on a good road and the time eight hours, we settle on 24 miles a day as an easier task than a quarter of a mile each quarter hour as in some of the monotonous beats of sentries or policemen. If the performance is to be 24 miles, we desire to take for it neither 16 hours a day nor yet 4 hours, but a time between 6 hours and 9, according to the preference of the worker; and it is further realized that the best standard of efficiency is not a maximum of muscular effort for a short time, nor a maximum of physical wear for a long time, but a combination of mental and physical exhilaration which leaves the worker in best condition at the end of the accomplishment, whether the unit of time be a few seconds, a day, a month, a year, or a lifetime.

Therefore, in this particular very limited application of efficiency reward the ideals are:—

(1) A guaranteed hourly rate.

(2) A lower limit of efficiency, which, if not attained, indicates that the worker is a misfit and requires either special training or change of occupation.

(3) A progressive efficiency reward, beginning at a requirement so low that it is inexcusable not to average it.

(4) An efficiency standard established after careful and reliable investigations of many kinds, including time and motion studies.

(5) For work to be performed, a time standard that is joyful and exhilarating, therefore intermediate between depressing slowness and exhausting effort.

(6) A variation in standards for the same work for different machines, conditions and individuals, the schedules therefore being individual.

(7) The determination for each worker of an average efficiency for all jobs over a long period.

(8) A continuous correction of time standards and of wage rate to suit new conditions. This is essential and inevitable. Wage rate rises f under the new conditions more skill or greater effort is required. Time standards have nothing to do with wages. They are not changed to affect earnings either one way or the other, but to be accurate and just. The time standard for covering a mile for a man on foot is inevitably less for a man on a bicycle, inevitably less for a man on a motor cycle than for a man on a bicycle.

(9) The worker must have the personal option of working not to a standard time, but between limits on each side of standard time. If he does not consider standard time fair, he can

take his assumed hourly rate and show lower efficiency, which greatly enhances the cost to the employer, whose self-interest has so to improve physical or psychical conditions as to induce the worker to attain standards.

Efficiency constitutes 9 out of the 18 elements of cost—efficiency of quality and quantity and overhead for materials, for labor and for fixed charges. It has been found exceedingly satisfactory and convenient to base efficiency rewards on the cost of efficiencies, the method being so flexible as to be applicable to an individual operation of a few minutes' duration, or to all the work of a man for a long period, or to all the work of department or plant.

Nevertheless, these various forms of bonus are but devices of great practical value, just as a foot rule or the multiplication table is of practical value, but for importance they are not to be compared to the broad principle of efficiency reward which is far above any particular device. It is therefore absolutely impossible for any combination of workers to prevent the application of the principle of efficiency reward if any management chooses to adopt it.

Efficiency reward is not a money payment, this is only one of its myriad forms. Men have been willing to die for a smile. Hobson relates that one man offered to forfeit a year's pay if they would but allow him to be one of the crew to sink the "Merrimac" across the entrance to Santiago harbor. Garibaldi offered his hearers hunger, thirst, hardship, wounds, prison and death, and in a frenzy of eagerness they followed him.

Highest efficiency is easily stimulated, although there is often no more direct connection between act and reward than in profit sharing which does not stimulate. In Jack London's elemental tale of the miner of Forty Mile, the girl he fought for was the direct prize. He would have had to fight if there had been no girl and he would have lost, but in Victor Hugo's "Toilers of the Sea," the man single-handed saved the wrecked steamer, not that he might profit, but that he might win a girl's love. The bitter tragedy lies in the fact that he had striven for a reward, made its hope the inspiration of his work when he should have known that it could not be attained in that manner.

Twelve principles of efficiency! We began with ideals, we end with ideals. Men must have ideals or they cannot do good work; there must be possibility of highest efficiency reward or neither senses, nor spirit, nor mind is stimulated.

He who would take ideals from the world's workers, he who would deprive them of the lure of individual reward for individual efficiency, would indeed make them brother to the ox.

He who believes the road behind humanity registers but a fraction of what is still to be attained, seizes on the principle of efficiency reward to bring to their highest development materials, muscle, mind, and above all, spirit.

XV

EFFICIENCY PRINCIPLES APPLIED TO MEASUREMENT AND CURE OF WASTES

The better prenatal endowment of all humanity, eugenics, is advocated by optimists. Favorable physical and moral surroundings, hygienics, are advocated by practical welfare workers.

Between eugenics and hygienics lies the almost untilled but very rich field of character analysis which helps the worker to avoid lines of endeavor for which he is not suited, which counsels as to the lines of endeavor for which he is fitted.

Chapter XV

EFFICIENCY PRINCIPLES APPLIED TO MEASUREMENT AND CURE OF WASTES

THERE have always been successful men. Alexander, Caesar, Attila, Jenghis Khan, Charlemagne, Timur, Hideyoshi, Napoleon—conquerors and empire builders; and these men unconsciously practiced, to a limited extent, some of the principles of efficiency. All their work, except perhaps that of Hideyoshi, is characterized by immense waste. Jenghis Khan is charged with the destruction and death of 6,000,000 human beings.

These men, even the most destructive of them, had ideals, often very high ideals, which they largely realized, but waste elimination was not one of them.

The ideal that inspires the formulation of the principles of efficiency is elimination of waste, of wastes of all kinds resulting finally in wastes of the collective human soul.

The mistake of the Hindu is that he is an individualist and seeks his own Nirvana, an essentially feminine task. The mistake of the Catholic monk making his salvation is that he also is an individualist, and is essentially feminine in his conception of the universe. The masculine ethical instinct is not self but family, clan, class, section, party, nationality, world—not individual aggrandizement, but the ultimate perfection of the whole world, the creation of an earthly paradise, and if man's progress is slow it is because of wastes—solely because of wastes—wastes of everything that is precious. How inconceivably slow has been human progress—waste of time; how the accumulated stores of nature have been looted, the forests, the fertility of the soil, the minerals below the surface—wastes of national resources; how inconceivably hard our tasks have been made for us! Cursed has been the ground; in sorrow has humanity eaten all the days of its life, thorns and thistles have we reaped and in the sweat of our faces have we worked. Wasted lives, sorrow instead of joy, painful, ignorant effort instead of glad, intelligent activity!

Elimination of all wastes may indeed be a Utopian ideal, not to be realized in the life of our planet, but any waste elimination brings its immediate reward. The miners in California, the forty-niners, panned gold, and no ground that did not contain $20 to the cubic yard was pay dirt. The cradle made $5 dirt profitable, the sluice box $1 dirt profitable, hydraulic mining makes dirt profitable that contains as little as $0.05 to the cubic yard. The early miners were not discouraged because they could not work $0.05 dirt; they manfully tackled and made their profit out of $20 dirt. What goes into waste is precious and recoverable value, and its elimination should bring big reward from the start.

The ideal of the Twelve Efficiency Principles is waste elimination, and to this end they have been formulated. The mere purpose for which waste is to be eliminated is not important. The condemnation of Jenghis Khan is not that he became a great ruler, but that he unnecessarily destroyed 6,000,000 human beings.

No navigator, whether pirate or merchantman, can make best time for himself and his ship who does not know great-circle courses, the shortest path from port to port, who does not modify his course as little as possible on account of intervening land, shoals, adverse winds, or currents. No man can achieve greatest success for himself, whether malefactor of great wealth or captain of industry, who does not eliminate wastes from his own operations.

There are ultimate ideals like universal peace, but a tremendously efficient present naval and military organization may further universal peace far more effectively than inefficient sentimentality and, even as an efficient navy would be most reluctant to enter on an unnecessary struggle (since its personnel by reason of its efficiency knows better than anyone else the hideous waste and cost of war), so it is almost impossible to conceive of an efficient leader being a great malefactor, or of a great malefactor being efficient.

It would not be a risky experiment to imbue a criminal of any kind with the principles that eliminate waste and to induce him to practice them, for in the end criminality and waste-elimination are incompatible, and also virtue and waste are incompatible, and there is more hope of bending the efficient sinner into paths of rectitude where he will accomplish much, than there is of making ethical progress with the inefficient.

Why should we formulate principles? Why

is intuition not enough? Intuitions are of tremendous value. They reach out into the future, they connect us up with the infinite, they pull down part of the divinity; but to call into existence what is not yet, has always been one of woman's, but not one of men's major instincts. We owe all the germs of civilization to woman's individuality, because she works alone; but what she has once started, men take over and develop on a gigantic scale.

Forty years ago I watched the workers on the Suez Canal. Many of them were girls, digging up the sand with their bare fingers, scooping it into the hollows of their hands, throwing it into the rush basket each had woven for herself, lifting the baskets to their heads, and carrying the load of 20 to 30 pounds a hundred feet up the bank and dumping it. Panama excavation is being done by steam shovels. Recently I watched one of them at work. The fingers of the Egyptian girl had grown into a thousand-times-larger steel claws that dug and scraped the shattered rock and dirt; the hollow of the girl's hands had developed into a scoop containing two cubic yards, or five thousand times as much as her two hands could hold; the rush basket had grown into a train of flat cars;

the shapely arm of smooth flesh covering muscle and bone had grown into a great beam moved by chains, flinging great loads onto the flat cars; and instead of the 100 feet of walking, long trains ran perhaps twenty miles to unload. Development by men of a woman's method.

Woman brings a baby into the world, but men organize a million grown babies into an army; a woman feeds her infant from her own breast, but men organize a commissariat department that encircles the world; woman teaches each separate human being to rise from all fours and walk like a man, but a von Moltke speaks the word and a million men tramp in time and measure; woman chews hides and greases them and smokes them into the softest leather, out of which she cuts and sews moccasins, but men take the hides of five continents and cut them into a million pairs of shoes a week; woman spins her single thread and weaves it into cloth, men run their thousand spindles and weave their miles of fabrics; woman makes tepees, but men build hundred-story-high skyscrapers, housing 20,000 people; woman croons her lullaby to her restless baby, but men organize grand opera, develop the phonograph; woman whispers to her lover at the tryst, but men by speech to multitudes secure presidential nominations and pile up for the presidency a million votes more than the triumphantly elected Cleveland; men connect their offices with all the other business offices in the country and shout their affairs across the continent, or send their danger calls two-thousand miles through the air.

It was Eve who ate the apple, but Noah who made the ark; it was Rebecca who deceived Isaac, Rachel who robbed her father, but it was Joseph with Pharaoh who organized the first trust to control the food supply and who ran the first corner in grain; it was Pharaoh's daughter who rescued Moses, but it was Moses and Aaron who organized the first strike and walkout. It was David who, with his followers, slew two-hundred Philistines, but it was Michal who let him down from the window; it was Saul who made Israel a kingdom, but it was the witch of Endor who, to help Saul, called Samuel back from the dead; it was Solomon who built the temple by collecting cunning artificers, by taking counsel of those who knew more than himself, but it was Bathsheba, his mother, who made him king.

Woman creates, men rarely create; they must work developing what is, and big work they must do through organization; but organization, however much its heads may have been selected and collected by intuition, must replace intuitions. Wastes, therefore, are not to be eliminated by intuition, but through principles.

The empires of Cyrus, of Alexander, of Charlemagne, of Jenghis Khan, of Timur, crumbled at their deaths because they rested on intuitive excellence, not to be transmitted to successors; but Caesar, Hideyoshi, English statesmen, the founders of the United States, Napoleon, Bismarck and von Moltke, transmitted organizations founded on principles. Most American industrial plants and business houses have come to grief in the second generation, and even corporations resting on special privilege like railroads and street-car lines, have passed into receivers' hands and undergone drastic reorganizations. In trying to control the great corporations, our statesmen, although men, are governed by intuitions not by principles, fail to swing the general government into line to do its part; they make the general government maintain disastrous and wasteful competition when what is wanted is principles that would work for elimination and equitable distribution of the immense gain.

Will the United States Steel Corporation endure? Not unless it succeeds in substituting principles, efficiency principles, for the intuitions of Carnegie, of Schwab, substituting efficiency principles even for the intuitions of that great genius, J. Pierpont Morgan.

The task before Judge Gary is a greater one than making steel, a greater one than harmonizing the steel producers of America, of the world; it is to inculcate those principles that eliminate waste.

It has often happened that in industrial plants where high efficiencies were being obtained, visitors confounding system with efficiency have come, have collected devices, cards and forms, have gone away supposing they had the secret of efficiency. It is as if a man should appropriate a lawyer's library and think this made him proficient in the law. There are milions of devices, forms, cards; no one can grasp them all, understand them all, and the chances are that not one of them will exactly fit in an untried place, even as no eye-glasses exactly suit any other pair of astigmatic eyes.

When, however, all the devices and methods can be collected under a few heads—ten, twelve, fifteen; when it is possible to show that a few principles cover all the possible devices—then the thinker can work backwards and ask himself what devices or methods or plans has he that will maintain (for instance) ideals, or that will give him reliable, immediate, and adequate records.

It is easy to test the efficiency of a plant because inefficiency is due to one of two causes. Either the principles of efficiency are not known, or they are not applied. If the principles are not used, high efficiency is impossible; if they are theoretically approved but not applied, high efficiency is also impossible. One of the main purposes of the principles is to give instruments of precision wherewith to test efficiency.

In going into a plant, seeing the evidences of great inefficiency, the first step is to find out what is; next, to set up standards; then to insist on the use of the principles, first to test the administration, and then to direct the plant, knowing with absolute certainty that if they are applied by a valiant and competent man, standards will inevitably be attained. There is, of course, no absolute and final standard. The standard initially adopted is always one plainly within sight, easily attained. A standard of 54 miles an hour from New York to Chicago is attained today; it would have been ridiculous twenty years ago. A speed of 25 knots an hour across the ocean was planned for and attained by the Mauretania and Lusitania; it would have been absurd in 1862, when the fastest steamer took 9 days and other good steamers were 12 to 13 days on the ocean.

Having ascertained what is, having set up standards, the plant manager and his counsellors ought not to go out and collect forms and devices and cards, ought not to install clocks and devices and checks, systems and methods, but ought to go into retirement and search their own minds and hearts and by some device or method test the extent to which they can apply principles. A convenient device is to assign a score card to each principle, to draw on the card a checker-board of a hundred squares, and by marking out squares record his judgment and that of other experts as to the extent to which efficiency principles are being applied.

The questions are not as to the number of employees, or whether the buildings are brick or wood, the equipment new or old, the employees men or women, white or black, free or unionized, nor where the plant and what the product is; but the first question is, "What are the ideals?"

To illustrate the method we can tentatively apply it to the greatest industrial corporation the world has ever seen—the United States Steel Corporation. From every point of view it ranks high, higher than most corporations. Organized only ten years ago, it started with the ideals of 1901, and if we have any belief in progress these were higher than the prevailing standards when the Standard Oil Company was struggling to the front. There is as much difference between the ruthless methods of the old Standard and the friendly dinners of Judge Gary as there is between the "eye for an eye" of the Old Testament and the Golden Rule of the New Testament.

Twelve years ago the steel business of the country was greatly disorganized. Every man did what was good in his own eyes. There was always a feast or a famine, very profitable or very ruinous prices; it had become an axiom that the condition of the iron trade was an infallible barometer of general business conditions. Very able men, financiers, lawyers, great steel producers, combined to bring order out of chaos, and the United States Steel Corporation was formed. It has been managed with great prudence and wisdom, perhaps with as great wisdom and prudence as industrial knowledge at that time made possible. It has recently been investigated and it is interesting to gather from the mass of testimony the ideals of both investigator and investigated.

The ideals of the Corporation seem to have been:

(1) Law abidence.

(2) Rational publicity.

(3) Steady prices at a high level.

(4) Maximum tonnage.

(5) Permanence for its own business by the purchase of large ore and coal reserves.

(6) Rapid improvement of the properties so as to make them worth the capitalized value.

(7) Maintenance of a high level of wages.

(8) Identification of the worker with the profits of his work, thus increasing his interest in his occupation.

These ideals are summed up by Judge Gary in a declaration in an address at Brussels to 160 representatives of steel interests in Europe and America, in which he declared that "There should be established and continuously maintained a business friendship which compels one to feel the same concern for his neighbor that he has for himself. It is nothing less in principle than the Golden Rule applied to business."

Critics have carpingly suggested that the principle should be called "The Golden Rule Limited" since it takes no account of mankind outside of steel. This is both unjust and narrow. The actual price of anything is not important, the relative price is, and even more important is it that relative prices should not fluctuate but gradually sink compared to labor. It is the immense merit of the Corporation that it has maintained prices of products and compensation per hour of labor, also that by eliminating useless wastes in selling and in fighting competitors it has been able to make good the ideals of corporate value set up in 1901.

The criticism ought not to be that it has eliminated several hundred million dollars of waste without any detriment whatever to the Commonwealth, but that it has not been able to eliminate *more* waste, and from the gain not only add to its own profits but also gradually lower price of products as measured in dollars, and increase the compensation, measured in dollars, of efficient workers, thus doubly adding to the purchase power of wages efficiently earned.

It will be interesting to use the United States Steel Corporation as a concrete example of the way the principles of efficiency might be of service to those who direct and administer large corporations.

Waste elimination *in production expense* has not yet become one of the effective ideals of the Corporation. Does it cost less or more to produce steel today than it did twelve or fifteen years ago? Is it not costing less per ton to transport freight, less per mile to transport passengers on the railroads, than it did fifteen years ago? Has the Steel Corporation attained a present rational low limit of cost of production? If it is not applying systematically all the principles of efficiency to every minutest operation, then naturally its costs are unduly high, and if it did apply these principles, its costs would be lower, with gain to all!

The Corporation has not applied the principles firstly because there were other vital and elementary problems more pressing, and secondly because the principles had not yet been formulated and their value to a very limited and almost unknown extent been demonstrated by F. W. Taylor, H. L. Gantt, James M. Dodge, W. J. Power, E. E. Arison and many others.

If the United States Steel Corporation were to be checked up by efficiency principles, ideals would be first formulated that would be of universal application, and the lesser ideals of the Corporation would be checked up in comparison. By this test as to the first principle, Ideals, it would be given high credit for some, fair marks on others, and as to others it would be found very defective. It could not be otherwise, since there have been men highly connected with the Corporation in whom the public could not have any general moral confidence either as to their comprehension or execution of ideals except of the lowest order. Tonnage, the shibboleth of steel production, is a low ideal working havoc in more ways than one.

Taking the next square, Common Sense, the Corporation has steered a remarkably wise course along a channel beset with many difficulties and with the materials at hand wonders have been accomplished. The Corporation is vulnerable only to small degree for what it has done, but to a large degree for what it has not done. It is not by any means as up-to-date as a modern American battleship which can concentrate repeated heavier salvo fires on a target at a greater distance in a shorter time than any other battleship in existence.

The square of Competent Counsel. Here again there appears to be deficiency of omission. Counsel has been taken in many directions, legal, financial, political, technical, but in other directions competent counsel has neither been invoked nor secured because its need was not realized.

In one Pittsburg shop there are fifty-six different nationalities employed, men of many different races. In London there has just met a Universal Races Congress with delegates from all nations and all the races in the world. (I know private American businesses that have sent members to this Races Congress in order to be better prepared to handle the race problems that occur in American shops.) Is the Steel Corporation represented there? If not, how could it afford to miss the opportunity?

Discipline and the Fair Deal, recognized as principles, have both been conspicuously insisted on, and both are intensely desired by the Corporation in spite of local murmurings and occasional sore spots, occurring solely because the principles have not been worked down far enough.

When it comes to the application of the principles of Reliable, Immediate and Adequate Records and of Determination of Standards, the Corporation does not rank high because it is only a systematized business, not one scientifically managed, because it has not yet emerged from the antiquated standards of accounting so beautifully developed by the Venetians shortly afer the adoption of Arabic numerals. The old principles of accounting plainly in evidence in a modern bank are three in number: (1) Destination; (2) authority; (3) balance.

In a deposit bank it is imperative to know where to credit a deposit, the destination of the account; it is so imperative to have proper authority for drawing out money that if a man's wife, or partner, or best friend attempted to check on his account the bank would be horrified and call on all the minions of the law to prevent and punish such sacrilege. The bank is happy when as to the whole and as to each account there is balance.

These ideals are fine, important and desirable, but wholly inadequate. The bank does not care how the depositor acquired the money nor how he spends it after it is withdrawn. Its supervision covers a very limited field. It is this limited field that corporation accounting has to date covered. It is not broad enough.

In the Illinois Central Railroad car-repair frauds under which the road lost about $5,000,000, destination was perfectly observed, for bills were charged to definite accounts; also as to every voucher authority was forthcoming, each being approved by some official; finally there was perfect balance between vouchers and expenditures. When the frauds were revealed, President Harahan pathetically mourned that trusted friends had deceived him.

The modern cost-accounting fundamentals are Standards, Efficiencies, Equivalents. The Lusitania in crossing the ocean steams a measured number of miles, in a recorded time. To do this requires about 60,000 horse-power, each horse-power hour requires a pound and a half of coal. I know nothing of the records of the Lusitania, I have never seen any of them, but off-hand I can estimate that it takes about 1,000 tons a day to run the ship. This is a standard, not a record.

There is, as to the Lusitania and all other large steamers in regular service on definite, fixed and measured courses, a predetermined standard of expense for coal; and against this standard, actual consumptions are checked, or may easily be checked for every voyage, closely compared, and keenly scrutinized.

If the Illinois Central had had standards for car repairs, any standard—$31 per car per year as Turner attained on the Pittsburg and Erie; $35 per car per year as Van Alstyne attained on the Northern Pacific; $42 per car per year as some railroads might think sufficient; $56 per car, an amount that any competent investigation will show to be too much; $70 per car per year, about the average of all the railroads —then the Illinois Central cost at the rate of $140 per car per year would have shown the following efficiencies according to the different standards:

Standard Cost per Car per Year.*	Efficiency at $140 per Car per Year.
$31	22 per cent
$35	25 per cent
$42	30 per cent
$56	40 per cent
$70	50 per cent

and there would have been instant inquiry by officials, by Wall Street, by shareholders, by

* Repairs per freight car owned is a defective unit, but the illustration holds good, as any other unit, repairs per car mile, would still show Turner and Van Alstyne in the lead, the Illinois Central far behind.

Interstate Commerce Commission, by rivals and critics, as to the why and wherefore of the low efficiencies, as to the absence of equivalence between moneys spent and results obtained.

The United States Steel Corporation has records of productive cost which it may think are standards, but they are not; they are mere records of what has been accomplished in the past, and there is absolutely no direct connection between what has been and what ought to be. Records grope in the past, standards reach into the future, ultimate standards are always ahead of what has ever been. Practical standards hang like stalactites from the roof of ideal standards, records are built up like stalagmites from the floor of actual performance; it is only when stalactite tip and stalagmite tip join and fuse that both become a column of efficiency strength. Does the Steel Corporation know as to every detail what *ought to be* as well as it knows what *has been?* If it does not, it is merely systematized; it cannot measure its losses, and where there is no standard there is inevitably waste, and very great waste.

We next consider the application of the principles of Standardized Conditions and Standardized Operations. Are conditions standardized to the same extent as in a railroad track, as in railroad cars and locomotives, always maintained in a high degree of efficient repair, because life is at stake if they are not?

Poor belting, poor abrasive wheels, poorly maintained machines, delayed deliveries of material, do not endanger life in the operation of an industrial plant; therefore nobody cares very much, and because nobody cares, because no alarm clock goes off, lax and slack conditions prevail. It is not even necessary to prove that laxity and slackness exist; the legitimate assumption is that they do unless the contrary is proven.

An eight-year-old child who has never been to school presumably cannot read, and to prevent arrest by the truant officer proof of efficiency has to be furnished by the parent to the municipal authorities. So with corporations who have not learned the alphabet of efficiency. In the Corporation have single operations been standardized, not only the centralized, supervised and oft-repeated operations, but also the decentralized, unsupervised, occasional operation?

Continual hammering on the same spike will ultimately sink it into very hard wood, it is an oft-repeated operation; but it is much harder to throw a stone straight. Therefore we hammer as did prehistoric men; the operation was almost as perfect then as now; but we have had to develop a staff of thirty men working all together to standardize such an unusual operation as throwing a 1,000-pound shot at an enemy's vessel.

Has the Steel Corporation so standardized conditions and operations as to enable it to draw up Standard-Practice Instructions covering all details? No one standardizes without reducing the standards to written form. The object of surveys is to make maps, more or less elaborate, that all may profit. If there are no maps of a region it is safe to assume that there are few and imperfect surveys. By its collection of standard-practice instructions the Steel Corporation could demonstrate its efficiency status, whether very elementary or far advanced. With a good chart in his hands one captain can replace another without danger even in risky waters. In industrial plants most of the charts are under some foreman's or worker's hat, and it would not be possible (as it ought to be), without loss, to walk in a new industrial army, privates and officers, and take up interrupted work, without delay or loss.

As to the next principle, Despatching, it is undoubtedly applied by the Corporation on a wholesale scale but not in detail. Large steamers laden with ore are regularly despatched from the far end of Lake Superior to the lower end of Lake Erie. Big apparatus is used for loading and unloading these steamers; but is each scoopful handled with the maximum of efficiency? As railroads have found out, it is quite as important to despatch passengers into trains and out of them again as to despatch the trains. In the despatching of minor operations all except standardized industrial concerns are weak.

Finally we come to the principle of Efficiency Reward. As to every human effort, for the highest result and for joyful, healthful effort, three conditions must prevail:

(1) There must be pleasure in the work; it must be a game, not a task; it must be what learning to ride on a bicycle or learning to skate is to a boy, or learning to dance is to a girl, or playing golf is to the elderly business man, or auto speeding to the automobile driver.

(2) There must be a definite end in view, a definite accomplishment in a given time, not a vague, never-ending grind.

We are not accustomed to endless day or endless night; both are depressing, and so also is a perfect unchanging climate or sea. Men want change, always change, the sting of the blizzard with the certainty of the broil of the camp fire at the end of the tramp. The ordinary man will scarcely hold his breath a full minute, but if trained by a single lesson and nerved to a definite task, timing himself, he can hold his breath for a minute and a half, for two minutes, for three minutes, or even for four. He acquires form.

(3) Form is the third requisite for easy, graceful, pleasurable work. Compare the skilled skater with the novice, compare the skilled man riding horse or bicycle, scarcely a muscle in use, with the frantic efforts of the learner, compare the dexterity of the juggler with the clumsiness of the imitator.

The Steel Corporation has installed the plan, the duty of profit sharing, but has it recognized the principle of Efficiency Reward in the great army of its workers? Has it set up a standard task in a standard time? Is there immense joy in each one's work? Is there perfected form in doing the work?

Minimum effort put forth in best form to attain a standard in definite time gives the joy of work, and this joy is added to the pleasure of securing the special reward for proficiency. Are these the conditions under which the steel workers labor? If not, the workers cannot be efficient and wastes are occurring.

Whether we check up the making of a pin and its cost or the operations for a decade of the greatest corporation in the world, the same methods can be applied to reveal weaknesses and to show the need of special remedies. The principles of efficiency are to the industrial plant what the principles of hygiene are to life. If man, woman or child does not have constantly changing air of sufficient purity, an abundance of good food and water, plenty of exercise as well as rest and sleep, constant keen interests and sudden changes, health will suffer, no matter what the occupation.

No matter what the occupation, no act is efficient if the principles on which efficiency is based are lacking.

Franklin collected thirteen principles to cover the small amenities of daily life. They were: Temperance, silence, order, resolution, frugality, industry, sincerity, justice, moderation, cleanliness, tranquility, chastity, humility.

Each week he picked out one and practiced it diligently, thus creating a habit. Each year he practiced each one a full week in each quarter, thus covering them all four times each year. He kept this up for many years. The uncouth Franklin of early manhood who found fault with his wife for giving him a silver spoon and a china bowl for his bread and milk instead of a pewter spoon and earthenware crock, developed into the statesman and man of the world who won the respect of Englishmen, the admiration of Frenchmen, and the gratitude of Americans. In a similar way ought the principles of efficiency to be applied and reapplied.

XVI

EXECUTIVE CONTROL OF LINE AND STAFF

The longer I live the more I am certain that the great difference between men, between the feeble and the powerful, the great and the insignificant, is energy—invincible determination—a purpose once fixed, and then death or victory. That quality will do anything that can be done in this world; and no talents, no circumstances, no opportunities, will make a two-legged creature a man without it.—SIR THOMAS FOWELL BUXTON.

Pharaoh demanded bricks without straw. Christ did not expect figs from thistles.

Shall we expect a man to be either contented, skilled or happy at work for which he is not fitted? —DR. KATHERINE M. H. BLACKFORD.

Chapter XVI

EXECUTIVE CONTROL OF LINE AND STAFF

INDUSTRIAL plants remind me of automobiles. The plants themselves may be more or less good, but on what kind of roads are they running? The philosophy of efficiency is for an industrial plant—for any enterprise, activity, or undertaking—what a network of good roads is for automobiles. Undoubtedly even on poor roads automobiles may make some progress; but the worse the road, the more elementary must be the means of locomotion.

Railroads, high roads, bye-roads, bridle paths, foot paths, mountain climbs! The unlettered mountaineer of all countries is the best man for the latter, and it takes the best kind of trained climbing expert to emulate him; but as the road is improved shoes are exchanged for horses, horses for bicycles, a change from one kind of muscular effort to another, bicycles for automobiles, automobiles for railroad trains, both these latter using uncarnate energy instead of muscular or incarnate energy. The all-around skill of the mountaineer becomes the subdivided, specialized skill of many different men who are supplemented with increasingly complex equipment.

The philosophy of efficiency is to be used to build roads along which any organization can travel with the least friction and the greatest advantage, and the more ramified and involved the business the more is the philosophy needed.

However, no highly complex automobile, even with the best network of roads, can make any great progress unless in the hands of a skilled directing intelligence—no highly complex human enterprise, though it uses all the principles of efficiency, can make any great progress unless guided by a skilled intelligence.

I remember a large manufacturing concern whose superintendent, a man of great energy, ambition, magnetism, had married the daughter of the owner and in time succeeded to the direction and management. The old plant was in smooth working order, its old employees had worn paths from their homes to their machines; routine, evolved and worn into a groove by many years of practice, made anything more than ordinary directing intelligence unnecessary. The superintendent, becoming president, resolved to build a modern plant in a new place, to equip it with up-to-date motor-driven tools. He did not know that he was tearing up the old foot paths and providing no new roads for his complex machine to run on. At the time of the move he scrapped not only intentionally the old buildings and the old equipment, but also unwittingly all the ingrained habits and routine of a generation. The old employees no longer automatically traveled from home to plant, no longer automatically acted as the cogs in the well oiled machine. They had to go several miles from their homes, over roads and by means that were new, to enter a strange plant where nothing was familiar, and to attempt work on new-fangled machines. Instead of jogging through the day like well trained car horses, stopping and starting at the jingle of the bell, they had to stop and take thought for every movemcnt. The plant drifted financially down-stream like a steamer with broken engines caught in a tide bore. Earnings fell off a million and a half, and then the president, discovering the situation, told me that in making the change he had foreseen five-years loss before he could be back to the excellence of the old plant. Perhaps he had foreseen it; but in that case, instead of being merely enthusiastic and inexperienced, he was little better than criminal; for, to foresee is to prevent, and as he supplied new and better buildings before he scrapped the old ones, as he installed new and better machines before he scrapped the old ones, so even to greater degree was it his duty to provide something to take the place of the old and scrapped routine—and that something was a modern controlling organization based on the philosophy of efficiency, an organization in which the president would have been great in proportion to his ability to serve and aid even the smallest tool in its work, and thus make it possible for the routine man, for the machines, to do their best. Because as a president he failed to realize his duties, his men worked listlessly two-thirds of the time on machines geared up to half-capacity, and his whole plant floundered along at scarcely 30 per cent efficiency.

The best plant in the world, the best philosophy of efficiency, will in themselves make no better combination than a good automobile on a network of perfect roads, with nobody to handle the starting and steering wheel. The most picturesque figure in all railroading is the locomotive engineer. In vain, back in the thirties, did a masterful conductor on what is now a part of the Erie system thrash a disobedient engineer into subjection and thus for all time in America establish the conductor's supremacy, a supremacy neither recognized nor existing in Europe; in vain do civil engineers improve roadbeds, tracks, bridges and terminals; in vain do builders make marvelous locomotives and more marvelous cars; in vain do general managers make schedules, do train despatchers issue orders, signal men turn switches; in vain do giants of finance combine roads into systems and systems into aggregations; trains could not run without the engineer in the cab, the man who slows up when the cow lingers on the track, who stops or smashes through according to his own instantaneous resolve when the bandit has piled obstructions on the track, who senses the signals rather than sees them in the stormy night, who, an hour behind at the start, runs into the terminal on time. After all the elaborate rules and regulations have been drafted, tried out, revised, and promulgated, there is inserted for the benefit of the engineer a saving clause absolving him from literal observance of any rule: "When in doubt pursue the safe course." If a runaway engine were overtaking his train, if a bridge were sinking beneath him into a swollen river, the engineer would run past any red light or block signal; and it is because of the ultimate supreme necessity of relying on the man, not on the machine, that railroad men are reluctant to substitute automatic train stoppers for the brain of the engineer. Other officials can doze at their posts, but the engineer must be wide awake and on his job every second of the time.

It was von Moltke using the staff to guide the line, not the mere fact of staff, that made first the Prussian and then the German armies invincible. It was Japanese intelligence that first enabled them to adopt line and staff, and later to use line and staff for victories even more momentous than those of Germany over France, for in the last two-thousand years many times has Teuton, many times Gaul and Latin been in the ascendant, different clans of the white race, in fierce but brotherly rioting with each other. Quite different was the struggle when Charles Martel turned back the Mohammedan African invasion of Europe on the field of Chalons, quite different when 940 years later Sobieski turned back the Mohammedan Asiatic conquest of Europe, and also quite different was the victory of Oriental over Slav at Tsushima and on the plains of Manchuria—a victory not of religion and race, but of efficiency over incompetency, of adaptable civilization and progress over feudal beliefs and reactions. Even as the cantons of Switzerland, the provinces of France, the American colonies, the independent States of Germany, the petty kingdoms and duchies of Italy, combined into united nations—even as the triple and dual alliances of Europe have combined for common civilizing action discordant and hostile races, so may we hope that the rise of Japan, the awakening of China, will enable West and East to combine for the advancement of a common humanity, a hope of which the first realization is the meeting just held in London of a Universal Races Congress, a meeting that above all else needed a master's guidance.

On personality, on the wisdom of the individual, whether locomotive engineer or von Moltke, whether the manager of a plant employing ten men or Judge Gary, chairman of the board of the gigantic Steel Corporation, will depend the ultimate value of all that creative physical or philosophical ability has brought together.

Recently there was submitted to me in the office of one of Chicago's greatest businesses, the draft of its organization. No man can pass on the merits of the details of a complicated organization without long and intimate acquaintance with its workings. Seeing the plan of the Chicago plant, pressed for a suggestion, I said, "Your chart is upside down; the president belongs at the bottom, sustaining and carrying, through his organization, all the operations of the plant. Because he is in supreme authority he has the responsibility of making available for every one, down to the tool, all the wisdom in the universe in order that each may fulfil perfectly its special duty and task."

Shortly after there was laid before me the chart of organization and operation of a great city which was attempting to substitute efficiency of civic administration for graft, self-seeking and party advantage. Again comments were called for, and again without intimate knowledge of conditions how could any of value be made? According to the chart there were various departments of civic activity, police, schools, fire-protection, water, streets, etc. These were the various lines, each separate and distinct from the other like the threads of the woof. Across them were to be woven the threads of the various staffs, engineering, accounting, law, hygiene, efficiency, etc. The admirable theory was that instead of each line department having its own engineer, its own system of accounting, its own legal counsel, its own efficiency engineer, etc., there should be a staff counsellor from each branch of knowledge, law, engineering, accounting, hygiene, efficiency—to advise all line departments. The plan was ideal; the woof of line, the warp of staff, would weave into a beautiful and strong piece of cloth; but who was to cut the cloth into a garment fit to wear? The weakness of the scheme lies in the strong human qualities of the various line and staff officials, and the stronger and more able these men are, the more trouble will arise. In the Middle Ages the little German and Italian States were constantly warring with each other. Lucky the peasant whose holding lay well toward the center of a small State—at worse he was robbed of all he possessed by his own kind lord; but if his holding was on the border, all his lord's enemies made a special point of harrying him, killing and destroying as well as robbing. Different lines are like the different feudal States; each, especially as to border lands, is fighting with all its neighbors. The street commissioner, after long research and experiment, lays what he hopes will be a model pavement, and before it has been open to traffic a month the water bureau tears it up to lay water mains. In running to a fire the fire department violates all the speed ordinances and police regulations; and the less important a prerogative is, the more it is insisted on as the visible sign of special privilege. Departmental lines are difficult enough to harmonize. In the usual industrial concerns the purchasing agent, the storekeeper, the order department, the manufacturer, the shipper, are all at war with each other, the stereotyped excuse being that the other fellow was responsible.

When into this family of Kilkenny cats the staff hounds are let loose, then indeed does fur begin to fly.

Each separate staff man is regarded as an invading enemy by each and every line head, and all the lines will combine against all the staff. Even if many of the men are amiable, sensible, patient, the conditions leading to discord and trouble are constant. The staff specialists constitute even a greater problem than the line heads, because as yet their duties and limitations are not so clearly defined. The accountant has mathematical convictions about the correctness of his tie-up with the laws of the universe, and because accounting, definite and accurate, is older than most other sciences, because it has made possible banking and merchandizing on a large scale, he starts in, full of enthusiasm, to impose his records on the various lines. These do not understand accounting; they have all the practical man's contempt for clerical entries and diagrams, they feel as did a tall friend of mine who over the shoulder watched an accountant figure up the contents of a coal pile and misplace a decimal. There was about 11 tons in the pile, the accountant made it 117, the seller promptly claimed 120 and compromised on 115. Another episode nearly forty years old comes to mind in which the eastern expert was to tally ties delivered by a contractor to the Union Pacific Railroad. They gave him a seat in the shade, they furnished sharp pencils and convenient pads, they showed him the heavy branding sledge with the raised letters "U P" on its face, they bade him watch the hefty navvy indent the letters in the end of a tie, and then on one side of the pile the talesman sat tallying each resounding blow, while on the other side the navvy pounded into the earth the stump of a burr oak and one or two ties in addition. What wonder that the rails and ties paid for were twice as many as required for the length of the road!

The practical man has often evolved for himself accounting methods of control, crude but eminently practical, and he bitterly resents the imposition of elaborate methods which do not aid control. There develops a festering petty antagonism between directing line and recording staff which vitiates the records. Suddenly into this hostility the efficiency expert injects his specialty. He exclaims that he wants standards, records of efficiency (i.e., the relation between standard and actual), and that he wants to convert efficiencies into money equivalents. The crude records of the practical man do not suffice, although they may form an excellent foundation on which to build. Still less can the efficiency engineer use the elaborate records of the accountant, since these do not tie in to efficiencies, do not give the check of equivalent. Over the lively and vigorous body of the line man the two experts wage their battle. Either records must be duplicated at useless expense and with added aggravation to all concerned, or one or the other must give way. In the meantime from the rear, the line man administers resounding whacks at both combatants, hoping that they will exterminate each other and leave him in peace. Suddenly the legal department comes along and advises both accounting and efficiency expert that their plans lack legality, that women cannot be worked on shifts of seven hours for ten hours' pay, because it involves one shift or the other working after 6 p. m., and this is against the law in Massachusetts.

For these clashes of line with line as to authority, of staff with staff as to knowledge and plans, for these clashes of each member of the line with each separate member of the staff, there is only one remedy—namely, the strong, governing and controlling executive, who need not be an expert in either staff or line, but who must have those qualities that fit him to direct, to harmonize, to convert a closed parallelogram of forces into an open straight line along which all forces are summed in the same direction. Everywhere this executive ability is needed.

It is much harder to manage a sledge team of eight dogs than it is to drive an equine four-in-hand, especially in starting in the morning. Sledge and eight harnesses have been strung out for an early start, the dogs have been given their single daily meal the night before. Very early a single dog is unchained and led forth and put in his harness, but by the time the second dog is fetched, the first dog has been looking for several imaginary fleas and tangled himself up hopelessly. Chaining dog two to the sledge, dog one is disentangled and dog two harnessed and strung in front of him. Dog three is then gone after, and while the driver is away dog one and two undertake to settle some grudges that have lasted over from the previous day. For the third time dog one has to be reharnessed and straightened out, for the second time dog two, and dog two and dog three strung in front. Happily dog three is quiet and peaceful, seems well manneredly busy with some minor affair of his own. Dog four is brought up, and then it is discovered that dog three has chewed one of his traces into bits and a new piece has to be spliced in—no pleasure at

5 a. m., with the thermometer 55 below zero, and the night camp 48 miles away! With each successive dog there is some fresh trouble; the hitching up and starting is the hardest part of the day's work. Trotting along hour after hour at 5 miles an hour over a well worn trail is rather enjoyable than otherwise. There is no inducement to stop and by noon 30 miles have been covered, by six o'clock 50 miles.

Recently I visited the Long Branch Horse Show and watched the mail coaches, the four-in-hands. How smart everything was! Appointments counted for much in awarding the ribbons. The harnesses were nobby, the horses sleek and high-stepping, the guard tooted his long horn, the driver held the reins just so, the cock-horse with his single-tree hooked to the saddle, galloped behind, ready to help at the imaginary hills. It was all beautifully smart, with that typical smartness which has made the English leaders in many things from table etiquette up to manœuvring battleships.

As I watched the fine turnouts, I recalled an earlier scene on the sage-brush deserts of the far West. Darkness coming on, a lumbering mail stage hung on leather springs, a paddock filled with wild, unbroken broncos! Eight horses roped and thrown, the rough harness buckled onto them somehow, their heads covered with grain bags! They were hooked by main strength to the dingy old stage, the bags were pulled off their heads, a pistol shot cracked and in a mad frenzy of rage and panic they plunged ahead. The driver's two tasks were to keep them on the jump and to keep them on the dark trail. Wild-eyed and madly they galloped at full speed for an hour, to bring up frothing and exhausted at the next station. The performance was not smart, it was rough and crude and primitive, but, Oh, it was driving! With a little practice this master of horses could have cut a figure eight with the English coach and high steppers, holding the ribbons in one hand, but also the immaculate driver at Long Branch could have learned in as short a time to handle the eight ponies through the dark night. He also was a master driver. It was the son of a lord who drove an automobile 1,535 miles in 24 hours and who later lost his life, one of the first of the aviators.

Whether on the grounds of Long Branch, on the desert trail, in a section, department, division, or plant of a great manufacturing concern or railroad, whether on the deck of a battleship, or on a battlefield, what is wanted is a leader who can swing and manage what has been entrusted to him.

In 1896, after six years of agricultural depression, after three years of financial distress, a tribune of the people suddenly united western and southern Democrats and secured also the support of one million populists. He had no organization or money, but in the west and south he piled up twelve-hundred thousand more votes, in the country as a whole nine-hundred-and-fifty thousand more votes, than the previously easily elected Cleveland. Then in the Republican party's hour of distress arose a man, a matchless organizer, for the sake of his friend and for the sake of his party politically absolutely unscrupulous, to whom votes were a mere matter of organization and money, and with a slush fund of thirteen million dollars (levied mostly from corporations) the campaign was organized. In different States single weak spots were picked out—Oakland in California, Portland in Oregon, eleven odd spots in Ohio, and when the farce of an election was over Mark Hanna had the count, McKinley apparently having received 1,548,246 more votes than his immediate predecessor. This election showed, as few other events have ever shown, what one man, a supreme planner and executive, can do when he has made up his mind. It is a comfort to turn from the skill shown in disgraceful party rivalry to a nobler executive skill. A reciprocity treaty is attempted between two great contiguous countries, each with over 3,000,000 miles of territory. Each separate member of a House and of a Senate has his own views as to the subject, its probably little effect on some little special interest of some little home supporter, all important to the political fortunes of the member. The quiet and judicial Taft, with no legislative functions, sits through the sweltering summer months at Washington and straightens out his line and staff, and the bill is finally passed. Had there been no strong executive there would have been no favorable American action on reciprocity with Canada.

The chairman of the board of the Steel Corporation is a lawyer, not a manufacturer nor yet an expert as to any steel or other manufacturing process, but he is an expert in controlling men; and the great corporation, taking perhaps a generation to eliminate losses that ought to be eliminated in five years, nevertheless develops and grows. The panic of 1907 was stayed not because it had spent its force, not because of the resources of great banking houses, but because one strong and capable man took the situation in hand, gathered into the library of his private house a hundred or more leading men, and by his executive ability brought order out of impending chaos.

It has become the fashion in history to decry the strong-man theory, to turn for understanding to evolution, to explain the strong man as the inevitable accident of the moment. There is evolution, there comes at last opportunity, but only rarely does the strong man arise; hence we have England, not Norway or Sweden or Holland; hence we have Prussia, not Saxony; Germany, not Russia; Italy, not Portugal; France, not Spain; Japan, not Siam or Korea.

In 1536 was born in Japan an undersized, monkey-faced boy of good but poor parentage, who at the age of thirteen resolved to make himself the chief power in the distracted kingdom. For 200 years the militant barons had warred against each other, each trying to grab, annex, and hold what he could.

The boy, Hideyoshi, deliberately visited the different courts, picked out the baron he thought most endowed with suitable character, succeeded with great difficulty in entering his service in the humblest position, and then steadily and inevitably rose, firstly because he could read human character and always knew almost as soon as they did themselves what his and his lord's enemies were plotting, and secondly because he was always prepared in advance for any undertaking and skilled in carrying out. Thus, when scarcely more than a child, he reduced the cost of firewood used in the palace to less than one-half; a little later he rebuilt the castle walls in three days, a task estimated as requiring sixty days; again, single-handed, he secured provinces that armies had failed to conquer.

By gifts of tact, of insight, of diligence, of readiness that each one of us thinks he possesses, that any one of Nipon's 30,000,000 inhabitants might have possessed and exercised, Hideyoshi arose step by step, until he directed and guided the whole country, his general Iyeyasu becoming the first of the Tokugawa dynasty which lasted from 1603 to 1867, with headquarters at Yeddo (Tokyo).

Temuchin, Jenghis Khan, born in a tent in 1162, son of a petty Mongolian chieftain, succeeded his father when only 13 years old. Many of the tribes immediately rebelled, but Temuchin held his own in battle and in counsel against open enemies and insidious traitors, until his empire extended from the China Sea to the frontier of Poland—an empire larger than modern Russia, the largest the world has ever seen.

Neither Alexander's, nor Cæsar's, nor Charlemagne's, nor Jenghis Kahn's, nor Timur's, nor Napoleon's empire endured. Personality alone is not sufficient.

> The tumult and the shouting dies,
> The Captains and the Kings depart.

Organization alone is not sufficient, equipment alone is not sufficient.

> Lo, all our pomp of yesterday
> Is one with Nineveh and Tyre!

I think that it was Bernard Shaw who wrote years ago that both Capital and Labor were powerless unless the man of ability condescended to use them. It was less than a half truth, for he magnified the importance of both Capital and Labor. More recent and less brilliant writers state with conviction and assumption of authority that all wealth comes from

Land, Labor, and Capital. Wealth comes not from without, but from within. Caruso singing for his pleasure draws $5,000 a night! A woman finds that her favor brings her a million dollars or an imperial crown! Ideals create wealth. What gives value to gold, to diamonds? What makes a square foot of land in parts of New York worth $1,000, other square feet in exactly the same locality not being considered of any value? Why is $500,000 (the value of a good-size industrial plant) paid for less than $5 cost of canvas and paint? The man of supreme ability is the one who has supernal ideals, who recognizes and uses those underlying principles without which human effort is futile, its results ephemeral. The man of supreme ability is the one who can create and control an organization founded on and using principles to attain and maintain ideals, who then is able to assemble for the use of his organization the incidentals of land, of men, and money (Labor and Capital), of buildings and equipment, of methods and devices. All these incidentals make for volume, for quantity, for man's work instead of woman's work, but they do not make for the spirit, nor for the quality, nor for the excellence of work.

What would not the physical properties of the Steel Corporation be worth if they were but instruments to supplement supernal men working through principles to realize supernal ideals? Moreover, if because of the hardness of their hearts, spiritual and ethical rewards are too remote to prove incentives, there are other and nearer rewards. Wastes, physical as well as spiritual, being eliminated, intelligence being prodigally lavished, time and money, efforts and materials being conserved, the cost of product will fall, thereby increasing the demand; more men will each receive more money in wages, thus still further increasing the demand for products; higher dividends will be paid, which will still further stimulate construction requiring steel.

It is impossible that righteousness married to wisdom should rule without immensely benefitting humanity.

> For heathen heart that puts her trust
>   In reeking tube and iron shard,
> All valiant dust that builds on dust
>   And guarding calls not Thee to guard—
> For frantic boast and foolish word,
>   Thy mercy on Thy people, Lord!

THE END.